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How the Chinese Government

by
WILLIAM GILMAN

Journalist and noted authority on Oriental military affairs.

One of the Type 240-A Waco planes delivered to the Chinese government. Note the position of the machine-guns and bomb-racks.

SHANGHAI, with only 30,000 foreigners (excluding Japanese residents and including American Marines) provides many headaches for its cinema managers.

With five first-run houses and a host of second and third-run shows they must, to make money, please the million and a half who comprise the Chinese population. Chinese are movie mad now and becoming madder. And so, while a few worthwhile pictures appear, the majority are imported with the idea that, "These surely will please the Chinese."

Jungle thrillers and pictures of war are best-sellers. With that in mind "The Eagle and the Hawk" was brought recently to Shanghai's newest showhouse, the Grand, frigidly modernistic in architecture and already plastered with liens. But the picture was a flop. That it failed so miserably is an interesting commentary on the modern Chinese mind.

I watched new China as it gazed at the unreeling of a drama which concerned the torture within the soul of a war-ace, Jerry Young (Frederick March). The spectators were frankly bored. They could not understand all this fuss about a Croix de Guerre wearer breaking under the strain of butchering the enemy. They could not comprehend his horror at slaying enemy youths who, like himself, were fighting in the name of humanity and "My Country."

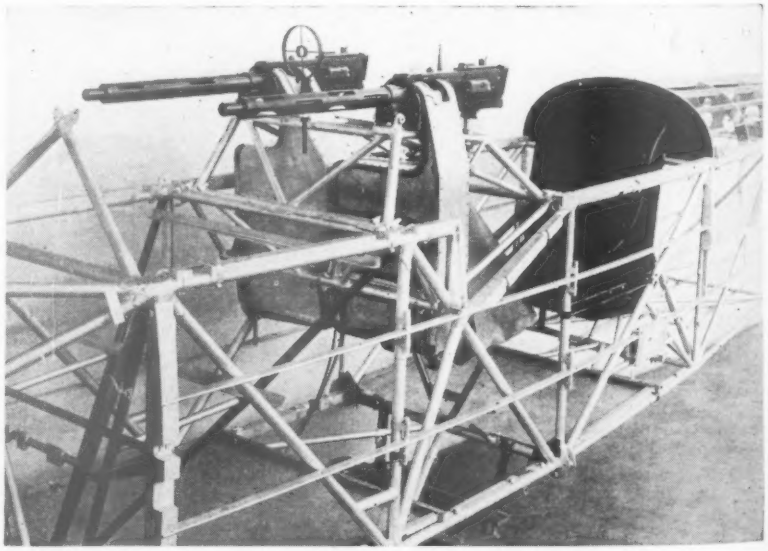
Boyish-bobbed Chinese beauties of the modern generation were rapt at the aerial duels and their faces glowed when Young's gunner shot down a fellow who was parachuting to safety from a burning observation balloon. It was a crack shot. But they could not grasp then why the gunner (Cary Grant) should be ostracized by his fellows, *maskee* his having broken the war flyers' code—slaying a defenceless enemy.

Chang Hsueh-liang, the "Young Marshal" who at one time headed Chinese aviation.

The faces of their escorts, clerks or students in the daytime and frequenters of cabarets or gymnasiums at night, were equally eloquent. They chilled when Young became a softy and confessed his horror of killing to a woman. It's bloody war the Chinese want and are preparing for.

I witnessed another show the following day. It had no element of pacifism and the audience roared approval. It was given free by the government as a gesture, a proof to the public that not all donations made to the China National Aviation Association fund had gone into graft-lined pockets. Traffic on the Shanghai bund was at a standstill. Chinese bankers and messenger coolies made common audience and dove for screaming handbills as five yellow machine-gun studded biplanes roared and sped above the Whangpoo River in spectacular antics.

It was a big day, a true gala. This was the first squadron to be baptized of the total of 18 Curtiss-Wright pursuit ships purchased in the United States. They had just been christened at Hungjao Airdrome and were named after their donors: "Shanghai Municipality", "Shanghai Workers", "Shanghai Boy Scouts", "Shanghai Colleges" and "Ningpo Residents." Painted on



Machine-gun mountings mounted in a special Fairchild plane constructed for the Chinese government.

Suddenly Became Air-Minded

CHINA, because of her military misfortunes, has recently become thoroughly awakened to the use of airplanes in her army. The author treats of aviation development in a most interesting manner and discloses many facts published here for the first time.

the wings of each was the inscription, "Not For Civil War."

China's Lindbergh, Sun Tung-kong, who had arrived in Shanghai a few days earlier after a flight from Europe, took part in the aerial parade. A score of fighting craft from Hangchow, where 17 American instructors are whipping China's air force into shape, added to the display.

Simultaneously with China's embarking upon an airplane-purchasing program, intended to make her sixth ranking air-power, plane manufacturers abroad have hopped off in a race to sell her aerial fighters.

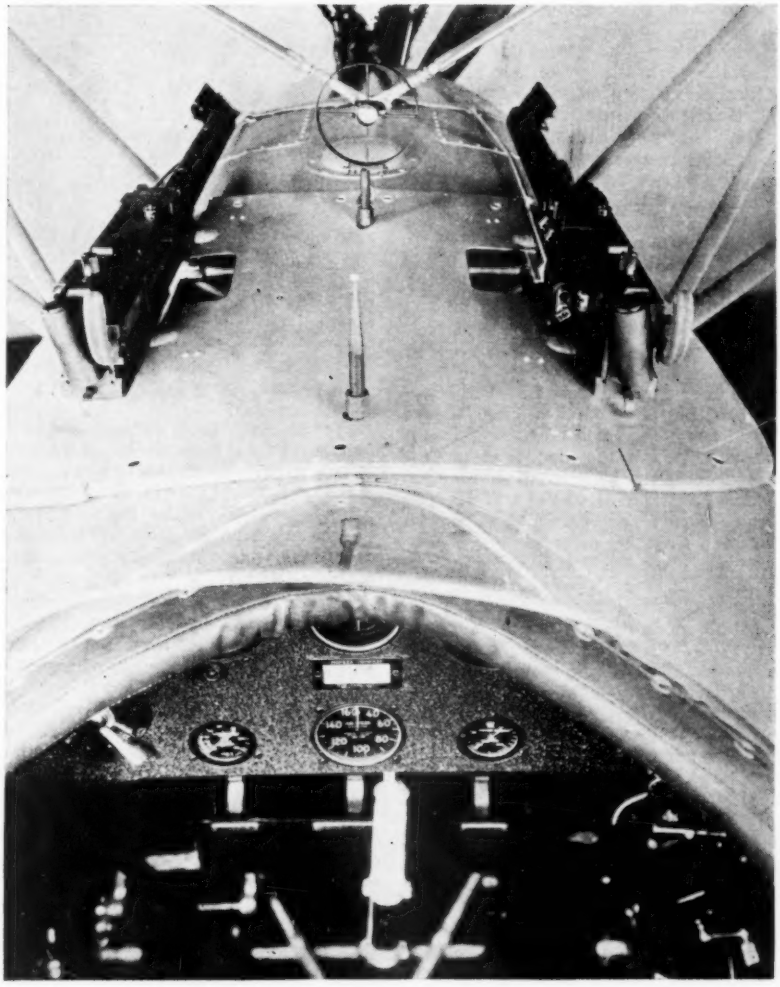
So far, the United States has found herself in the position of being the most-favored salesman. But she will have to fight hard to keep her advantage. Both England and Germany now have men placed in Nanking in the capacity of aviation advisors to the Central Government. While, on the one hand, their job calls for them to train China's air-force of the future, on the other they are commonly understood to be boosters of home products.

Another eager rival has appeared for the market. It is Italy. She is trying both the American and Continental methods of drumming up business. She has donated an aviation advisor, too, who has just arrived in China. He is Major M. de Bernardi, her war and Schneider Cup ace. Sale of Fiat bombers will be his specialty. Another job will be the organization of a school for Chinese pilots.

Italy is alive to the success of American sensational methods and Major Bernardi will have to do some spectacular flying in addition to the drier task of advising the government. Major Jimmie Doolittle pulled some hair-raising stunts over Shanghai last summer in a Curtiss-Hawk. He returned to the United States with an order for thirty-six similar pursuit ships. Eighteen of them are already in China; the remainder are expected soon.

A new Chinese Air Mission, now touring Europe, not only obtained the war-ace in Rome but is reported also to have closed a contract for twenty latest type bombers. Thirteen Fiat bombers came to Nanking's major airdrome, at Hangchow, last year from the same source. The air mission goes next to England and is expected to close some deals there.

Another air mission is touring Europe, an unofficial one. It is headed by



Looking down the gun-tunnel of an American built Chinese fighter. Note the ball-and-ring sights placed between the guns and also the instrument board below.

Chang Hsueh-liang, known and loved throughout north China as the "Young Marshal" until the disastrous Jehol campaign last winter. He left the country for Europe after that, in disgrace, with Chinese patriots calling loudly for his death. Sharing ignominy with Chang for the failure of that campaign was Tang Yu-lin, the renegade opium warlord of Jehol who did not choose to fight but chose instead to pocket money given him for resisting the Japanese by his chief, the young marshal. "Death to Chang and Tang!" rang throughout the major cities of China.

In the course of a year Chinese have become kinder to Chang. They realize now that he was served by traitors. They realize also that the country's big generalissimo, Chiang Kai-shek, has many things to explain concerning his conduct. One is the way he let Chang do his fighting alone in the north, made a "fall guy" of him, so to speak. On the other hand, of course they cannot yet pardon young Chang for being so completely a dope addict at the time of national crisis. To make the picture worse he was paying $50,000 (Mexican money) monthly for a type of narcotic that could be obtained only in Japan.

But big men become small and small ones become big rapidly in China. The country is in chaos and there is always room for a man to come back. Reports are to the effect that Chang Hsueh-liang is in the best of health now, having cured himself. Being wise to such things he had what is estimated to be $80,000,000 deposited in American and Canadian banks in anticipation of the debacle. He can afford to travel and wait. Already there are reports that he expects to be back in China soon.

His big interest is in aviation. His

was the biggest air force in China before the Manchurian "incident." When the Japanese captured Mukden, they confiscated the young marshal's 80 planes. During his stay in Peiping, Chang had two tri-motor Ford passenger planes for his personal use. Perry Hutton, who piloted one of them, was the highest-salaried American in China at that time, drawing $2,000 U. S. money monthly.

In his present tour, Chang is missing nothing aeronautical. He has inspected the air forces of Italy, France, England and Russia. He has been feted everywhere by these powers, who see in him a future customer. He is certain to be that. Chinese are least fitted of all nationalities to live as expatriates. Things will ripen in China and he will return. If by that time there is a unified China he will probably be the Minister of Aviation.

So far, England has had little success selling planes to Nanking but she has been doing good marketing in the south. The Canton and Kwangsi air forces number more than a hundred planes, a majority of them of English make, with a fair sprinkling of American and French products.

A more or less hazy Nanking program calls for 23 squadrons of airplanes and seaplanes, four of dirigibles and 11 of anti-aircraft units to be ready by 1935, in accordance with a three-year plan. This will bring her total number of fighting machines to more than 700. China's total air force will then eclipse that of 700 now owned by Poland and will make her seventh ranking air power, behind America, Britain, France, Japan, Italy and Russia.

Few accurate figures are known about the various air forces in China but observers say that the total now numbers about 300 planes in serviceable condition.

Tact is used in avoiding mention of Japan when government officials discuss China's air ambitions. Their argument that an efficient air force will keep the country in order has factual basis. Already government forces have used airplanes in fighting the rebellion in Sinkiang as well as the Chinese Communist forces in the interior.

A gigantic airdrome has been completed at Nanchang, headquarters of Generalissimo Chiang Kai-shek's anti-Red campaign. It can accommodate 300 planes. Two others are being built at Nanfeng and Kian, nearer Communist territory. Twenty Ford bombers, now being assembled in the United States, will be taken immediately to Nanchang from which place a miniature air force already operates.

A Curtiss bomber built for the Chinese Army which bears the earmarks of a specially constructed "Condor" transport plane.

Without doubt, China's eyes are looking upward and there is little difficulty in raising money for air uses. A ticket sale for the third of a series of gigantic state lotteries is now under way in territory controlled by Nanking. It is a Mex. $5,000,000 affair. Half of that sum is net government profit, the rest winnings for lucky ticket holders. The government split goes to buy planes. Government officials have had 10 percent. of their salaries set aside to swell funds of the National Aviation Association.

Not all of this, of course, is altruistic. There is one shady reason for all this government-sponsored air-talk. To pacify the patriots, disgruntled with Nanking's maladministration internally and puerile resistance to Japanese aggression from without, the government is ballyhooing the air-force of the future. Accused of making a private peace through its bankers with Japanese interests it replies by asking wage earners to buy airplanes.

"After all," says Nanking, "one cannot butt a wall." It has no navy, no air force and a vast, unmodernized aggregation of armies. Salvation, it says, is in the air, and the people believe.

In this connection it is interesting to note the latest frothing by Japanese propagandists, paid by Tokyo's War Ministry for the purpose of creating a state of alarm, hence to facilitate passage of a fat budget. They have declared that it will soon be necessary to land troops on the coast of Fukien province, south of Shanghai, if the Communist menace there does not cease and peace of mind to Japanese enterprise is not restored.

One reason for this interest in the south is said to be a desire to frighten Canton which has ever been in the forefront of those calling, "Down with Japan!" Another is to prevent fulfillment of hypothetical plans made in Washington, whereby the United States, with China's knowledge and connivance, will build a naval base on the Fukien coast, thus threatening Formosa, Japan's rich island nearby.

A third reason for invasion of Fukien, say outspoken Japanese militarists, is that such action would prevent opening of the contemplated Shanghai-Manila airline which, they claim, and prove somehow to their own satisfaction, would amount to a Sino-American alliance, threatening Japanese prestige in the Pacific.

Not all aeronautical development in China is concerned with the military. With the inauguration in October, of regular airmail and passenger service between Shanghai and Canton, the not-so-remote possibility of an air transport schedule across the Pacific came another step closer to realization.

That is of international importance. Of national interest in China was the fact that connection of the two important business and political centers represented another thread that is bound to have tremendous importance in bringing straggling ends of the republic nearer together.

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A squadron of five 240-A Waco fighters recently delivered to the Chinese government.

Nungesser — the Man of Iron

by CARL B. OGILVIE

Captain Charles Nungesser, the famous French Ace, was a man of almost unbelievable endurance and doggedness. He holds the world's record for being shot down by enemy planes, but outlived the war only to become the victim of an attempted transatlantic flight.

THE most amazing pilot of the World War was Captain Charles Nungesser. He was a "pilot for punishment." He was shot down more times than any other pilot in the world —seventeen times wounded! He had more pieces of metal in his body than medals on his tunic and he was awarded every medal a fighting pilot could receive.

Yet, in some mysterious—yes, miraculous fashion—this French airman's rugged, sturdy body resisted the pain and the weakening effects of many injuries and wounds and kept him in service during the entire war. Nungesser, one of the great Aces of France —ranking third in number of victories —despite his battle-scarred body, won 43 victories; many of them were balloons.

A curious twist of public sentiment was that, contrary to the custom of the war days of watching the papers and growing enraptured over each new success of an Ace, the French people actually became more interested in Nungesser's increasing number of forced descents and wounds. In cafes I frequently heard excited French arguing whether it was Nungesser's thirteenth or fourteenth wound, rather than whether he had won his thirtieth or fortieth victory. He had become a living symbol—albeit a bullet-punctured and battered one—of the eternal conflict of humanity against Fate.

Before the war, Nungesser had won prominence as an athlete and boxer. He went into the prizefight ring and knocked his opponents out without ever once being knocked out himself. In the air this Frenchman gave one knockout blow after another to Old Man Fate and never took the count from the Grim Reaper referee. His countrymen lionized him, called him "The Iron Man." He must have been.

If it had not been for his early physical training and the superb condition of his brawny-shouldered body, Nungesser would never have lived to be wounded 17 times. Even so, it seems incredible that the human body could withstand the breaking and tearing, the agony of pain, as many times as this Frenchman's body did. Reserve strength and energy must have given him amazing recuperative powers almost beyond belief.

Time and time again he went down to earth—once shot in the mouth—to crash his face into the instrument board, to wrench and tear tendons, shatter bones, and completely wash out his plane. But always the indominable spirit of Nungesser and his body, trained to take severe punishment, brought him back from a hospital bed to fly and fight again . . . to kill again . . . to go crashing down again . . . and again.

"What kind of a pilot was this Frenchman? What kind of a fighter? Why was he wounded so many times?" you ask.

He was daring. Heedlessly and astonishingly reckless. Above all he was a man of great courage—fearless. He fought with terrific amazing ferocity. Nungesser would tackle any number of Fokkers and Albatrosses. With the odds stacked staggeringly against him he tore in savagely, with utter abandon, intent upon knocking every enemy plane in sight out of the sky, or be knocked out.

He gave no quarter; expected none. Watching him put on boxing gloves and get into a ring was to see a solidly-built man wade into his opponent to strike the first staggering wallop. In the air he used the same tactics. Nungesser seldom feinted or jockeyed for an advantage. From any altitude or angle in the sky he would dive or zoom viciously to an attack. In his own mind, the outcome of each battle was a foregone conclusion. Either he would win another victory or be shot down.

His fighting tactics in the air were those of Guynemer, Dorme and Heurteaux—the quick dive, fire and pull-away method. Nungesser put everything into the first attack, calculating it was win or lose in the short flash or 20 seconds. He knew if he were to be victorious, to live to fight another day, he must fly skillfully, fire with great precision and, having fired, pull away with everything he had and look for another adversary.

Captain Charles Nungesser, ex-boxer and athlete, was the most amazing pilot in the World War.

Charles Nungesser first enlisted in the cavalry and saw service with the Hussars at the beginning of the World War. Within two weeks he won the *Medaille Militaire* for exceptional bravery. Requesting a transfer to the Air Corps he quickly learned to fly. When he won his brevet he was assigned to duty with the Nieuport Escadrille 65, then stationed at Luneville. There he got in many dangerous hours over enemy territory convoying bombing planes. He took part in 53 day and night bombardments of German positions. Nungesser displayed such remarkable skill as a "*pilot de chasse*" he was assigned to pursuit work.

Flying a little Nieuport, with a 20-pound Lewis gun mounted on the top wing, he was a marvel at maneuvering and aiming his ship at a foe so that the Lewis bullets found their desired

mark. He became known as the "Flying Banker" because he flew bankers' hours. From nine in the morning until three in the afternoon he was constantly in the air, searching, fighting. He was only on the ground long enough to eat and refuel his ship. Attacking a German he rarely failed to inflict severe damage.

By the end of the Somme offensive, half of the escadrille's victories were accredited to one man—Charles Nungesser.

* * *

WHILE testing a new machine during the latter part of 1915 he was severely injured. A leg and shoulder were broken and he suffered internal injuries. So severe were the injuries that a less hardy nature and poorly-conditioned body would have collapsed. For days the doctors thought Nungesser would die.

The Air Corps wanted to discharge him as physically unfit. That burned the French Ace up. He refused to be discharged. Instead he stole away from the hospital and hobbled to the airdrome with the aid of a cane. Despite the fact that his broken leg was still encased in a plaster cast he took off. The Germans were making a desperate assault on Verdun and Nungesser raced to the defense of that city, which had become a symbol of "unyielding determination" to all France. Near Verdun, Nungesser shot down two German planes and an observation balloon. Physically unfit? The French hadn't yet come to know him as "The Iron Man."

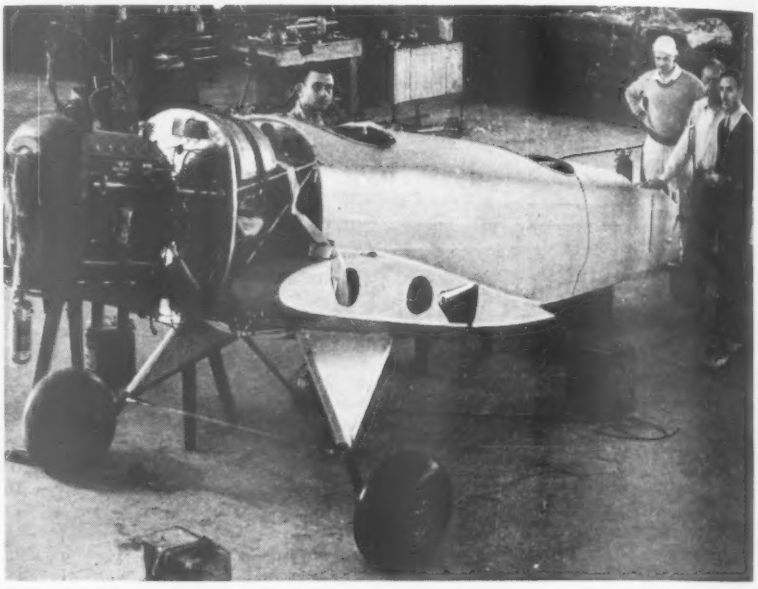
Strange as it may seem, Nungesser, who was for a long time outranked in number of victories only by Fonck, was never offered the opportunity of becoming a member of the most distinguished squadron of French fighting pilots—The Cigognes. To this squadron only the best fighting pilots were assigned to duty and Nungesser certainly deserved the honor of being assigned to duty with "The Storks." But Nungesser was never sent to fly with the best France had in the air, yet for days his total victories see-sawed with Fonck and Albert Ball, the British Ace, for first place. That he felt slighted is apparent in his action of flying with the first American pilots to appear at the Front.

Nungesser was on leave, enjoying a well-deserved vacation, when he met up with Yank pilots flying for France. He liked those eager, alert Americans and for two months at Bur-le-Duc he flew daily with Bill Thaw, Lufbery and the other lads of the Lafayette Escadrille. Of course, Nungesser was not officially with the squadron and the victories he won were not, to my knowledge, accredited to him. Every Lafayette man I met told me Nungesser was "a hell of a fine fellow and a damned good pilot!"

One time, while on leave in Paris, Nungesser met the notorious woman spy Mata-Hari and frequently they were seen together arriving or depart-

(*Concluded on page* 396)

A New Cornelius Self-Stable Plane



The Cornelius plane in the shop showing the method of connecting the variable wings to the body stubs. The entire outer wing moves—there are no ailerons.

A NEW departure in airplane wing construction has been introduced to Southern California flyers by G. Wilbur Cornelius after eighteen years of research. Called the "Fre-Wing," the new low-wing monoplane has been successfully flown in a series of demonstrations and will soon be manufactured in a Los Angeles factory.

Due to its unorthodox construction, the inventor claims that the new wing construction makes the plane virtually "foolproof." He backs his claim with a demonstration of "hands off" flight, climbing out of the cockpit and sitting astride the fuselage while the ship flies itself.

Instead of being stationary, the wings move on an axis situated at the exact center of lift which is approximately one-third of the distance from the leading edge to the trailing edge of the wings. The entire wing surface is moved at the pilot's will from the cockpit, no ailerons being used, as the wings themselves serve in this capacity.

Floating as free units, the free wings operate in unison with the tail surfaces on the present ship. Some of the advantages given, according to designer Cornelius, are freedom from stalls, tail spins and elimination of shock to passengers and pilot while in bumpy air. Wing flaps on the trailing edges aid in restoring the craft to level flight when the center of lift is moved by uneven air.

Greater strength is claimed due to the stress being placed on the center of lift when the craft levels off after a steep dive, this eliminating torsional stresses.

Landing speed is reduced from 10 to 15 miles per hour over conventional types of planes due to wing flaps. The current model cruises at 125 m.p.h., lands at 45 and has a top speed of 147 m.p.h. It consumes seven gallons of gas an hour at cruising speeds and has a seven-hour gasoline capacity.

The ship will be built in quantity at Metropolitan airport, Los Angeles, by Cornelius and his associates.

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The Cornelius monoplane assembled and ready for flight. Notice that the outer wing is depressed below the stub, thus doing away with the necessity for ailerons.

Gasoline — Aviation's Backbone

by KEITH J. FANSHIER

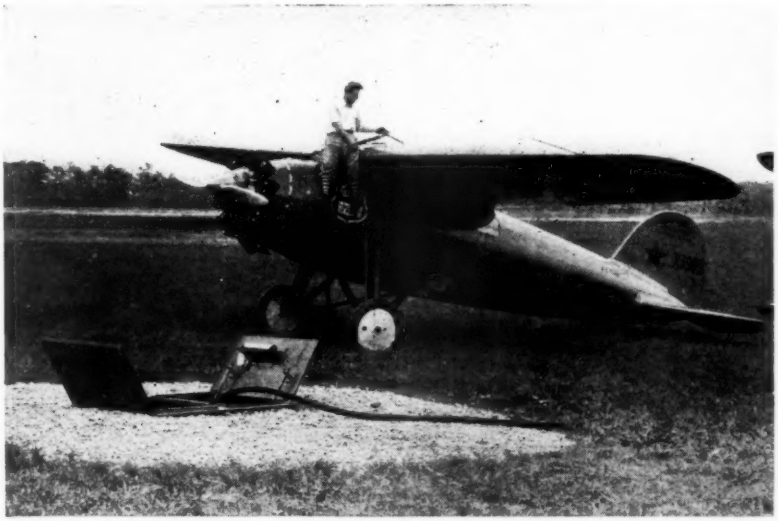
The author, an authority on the marketing of petroleum products, gives our readers an insight into the production and sale of aviation gasoline. This should be of particular interest to airport operators.

WHEN aviation is in position to require and demand more and better petroleum products as fuels and lubricants for operation of its ships, the petroleum industry will be able to come through with the required products.

Last year the consumption of petroleum products in the United States for aviation purposes reached an estimated total of around 60,000,000 gallons, of which some 96 percent. was gasoline. It might be said that this entire amount of gasoline was of high quality, refined and developed specifically for the exact purpose for which it is used. With a market of this nature and extent, the petroleum industry is jealous of its reputation and proud of the achievements it has made in supplying meritorious and dependable products.

The bulk of the gasoline consumed for aviation purposes in the United States is supplied by major companies. Half a dozen majors, between them, get virtually all the business. Heading the list is an organization of four Standard companies grouped in a common enterprise known as Stanavo Specification Board, which supply aviation gasoline of uniform specifications and quality from coast to coast.

The four are: Standard Oil Company of New Jersey, Socony-Vacuum Corporation, Standard Oil Company of Indiana and Standard Oil Company of California. These Standards, with their subsidiaries, blanket the country not only in serving motorists, but in supplying aviation with motor fuel. Two other companies which are strongly competing for aviation gasoline business are Texas and Shell, while Consolidated (Sinclair) has also been supplying some of the larger commercial aviation companies, as well as governmental agencies, with aviation gasoline for their needs.



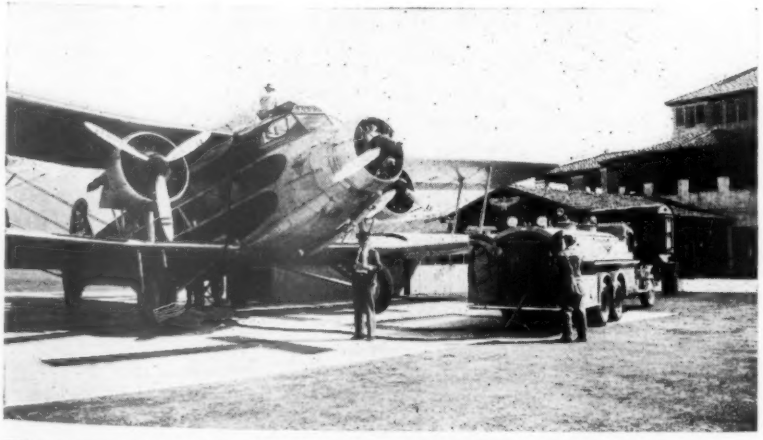
Filling the fuel tanks of a monoplane from a field hose-pit. This is at once a convenient method and a safe means of field supply since the cover of the pit closes flush with the ground level.

What is aviation paying for its gasoline? The actual price to the army, the navy, and to the large transport companies naturally depends pretty largely on the terms of the contracts under which it is supplied and it often is made available at prices which would appear on the surface, comparatively low.

However, it is interesting to note that current tank wagon prices at airports available to any and all buyers on aviation gasoline range only a few cents a gallon above the price which the motorist pays for premium or Ethyl gasoline when he buys it at his corner filling station.

Here is an interesting table showing the price per gallon at airports at various fields in or near important population centers in the United States, as of recent date. The prices are what the oil industry calls "tank wagon" or "laid-down" prices from the tank truck, and include federal and state taxes. These taxes range from three up to as high as eight cents in Tennessee, and seven cents in Arkansas and Louisiana:

Locality	Tank-Wagon Prices per gal.
Chicago	19.3
Indianapolis	20.7
Detroit	20.0
Milwaukee	20.2
Minneapolis	19.9
St. Louis	17.2
Kansas City, Mo.	18.7
Fargo, N. D.	20.9
Wichita, Kas.	17.6
Newark, N. J.	16.5
New York City	19.0
Boston	21.0
Philadelphia	19.0
Pittsburgh	19.5
Cleveland	19.5
Little Rock, Ark.	23.0
New Orleans, La.	21.4
Chattanooga, Tenn.	25.2
Dallas, Tex.	20.0
Denver, Colo.	21.0
Helena, Mont.	25.5
Salt Lake City	25.0
Phoenix, Ariz.	21.5
Los Angeles	13.0
San Francisco	15.0



Filling a transport plane with gasoline delivered by a field tank-wagon. The gasoline flows under pressure into the plane's tanks.

It will be found from the above table that, while there is considerable variation in gross prices at the various points, the net prices when taxes are deducted, are not far apart. The differences further are reduced when freight rate charges are deducted. These elements do not appear to be operative in the case of prices in Los Angeles and San Francisco where, at this writing, it is understood a price war is in progress, making the net price of high grade aviation gasoline at Los Angeles about 9 cents a gallon.

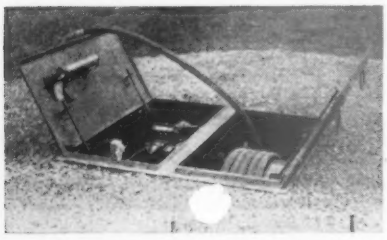
Gasoline, known as Aviation Fighting Grade in the wholesale or tankcar market, runs approximately one-half cent above the grade which is generally quoted next below it. It is a gasoline with an initial boiling point around 90 degrees Fahrenheit and an endpoint of 329 degrees. It is a product which, from various angles, is far superior to that commonly sold for and used in motor cars. Another gasoline, commonly sold at some airports, is the standard 68-70 gravity, 350-360 endpoint class.

Even though aviation and the petroleum industry have been cooperating for some years, no standard set-up is as yet in existence with regard to the handling of gasoline at airports. Major companies, which have gone in for aviation gasoline business in a big way, think nothing of an expenditure at an airport far exceeding that which might be necessary to handle the business of an automobile filling station. To some extent, it is a question of good-will. Oil companies are particular to impress on pilots, and those interested in aviation generally, that their products are high grade and unvarying. Another angle to be considered of course is the general advertising factor.

Many oil companies at the present time assert that their return from aviation gasoline business is still far below what they find necessary to consider it successful from the immediately commercial viewpoint.

At some airports storing planes, the port owners conduct the enterprise of selling gasoline along the lines common to automobile garages, selling gasoline to the planes as needed. At other places, the business of selling the gasoline may be in the hands of the oil companies themselves through previously installed facilities. They in some cases make their dumps into their own storage facilities and dispense from these direct to the planes. These facili-

(*Concluded on page* 398)



Detail of a gasoline hose-pit of the field type.

The Nemeth Circular Wing Plane Tested

by MAX KARANT

This view of the Nemeth circle plane shows many unusual features among which is the unusually sturdy cabane bracing between the wing and fuselage.

FLOATING lazily to the earth at Curtiss-Reynolds airport, Glenview, Illinois, the freak circular-winged monoplane shown above touched the ground in front of a battery of newsreel and newspaper cameramen at the surprisingly low landing speed of 20 miles per hour.

Stephen Paul Nemeth, veteran Chicago aeronautical engineer, designed the machine in an attempt to answer the prayer of the sportsman pilot—low landing-speed, high cruising-speed, maximum stability at all speeds and the utmost all-round safety. The ship was instantly dubbed by Nemeth's pilot, Dwight Morrow, the "Backyard Flyer." It is said that the airplane will land and take off within a 50 foot circle, rivaling the performance of James O'Donnell's "Doodle Bug" and the Autogiro.

The machine has an Argo fuselage that Nemeth lengthened to 17 feet. Duralumin tubing is used throughout. The landing gear is of the conventional type and air wheels are installed.

The tail assembly is normal with the exception of an inverted horizontal stabilizer which has the curvature on the underside instead of on top. This is believed to counteract a slight inherent nose-heaviness.

Originally flown with a 90 horsepower Lambert engine, the ship was found to be underpowered, so a 125 horsepower Warner engine has been installed. With the new engine, the "Backyard Flyer" has a top speed of between 110 and 120 miles per hour, cruises at 95-100 and has a rated landing speed of from 20 to 25 miles per hour.

The most radical part of the ship is the circular wing which is 16 feet in diameter. It is constructed of wooden spars and a special wing curve, designed by Mr. Nemeth, has been used. The entire structure is extremely well braced, as the photograph shows. A speed arresting flap, 5 feet long and 2 feet wide, is built into the trailing edge of the unusual wing and is lowered by the pilot to reduce the forward speed when making a landing.

Conventional ailerons are used and are of such size that, according to Mr. Morrow, the machine is quite sensitive to their use. Test flights are now being flown at Curtiss airport and, to date, the ship has given satisfactory results. No altitude test has been flown as yet, but Mr. Nemeth claims a surprisingly high service ceiling for his craft.

Attempts have been made at designing airplanes with circular wings from the earliest days in aviation, the old McCormick "umbrella plane" tried out at the old Cicero Field in Chicago, being one example. But in all cases, these early umbrella types were failures, not because of the principles involved but for the reason that they were too early for their time.

Should Nemeth's plans materialize, the new ship will be placed in production and marketed as a two-place, open-cockpit monoplane. It is hoped that the machine will be accepted as the flivver plane that has been the dream of the aeronautical industry for many years and, as the plane is only 8 feet high, is probably the only airplane that could be compactly fitted into an automobile garage.

The Dewoitine—France's Finest

by FLETCHER PRATT

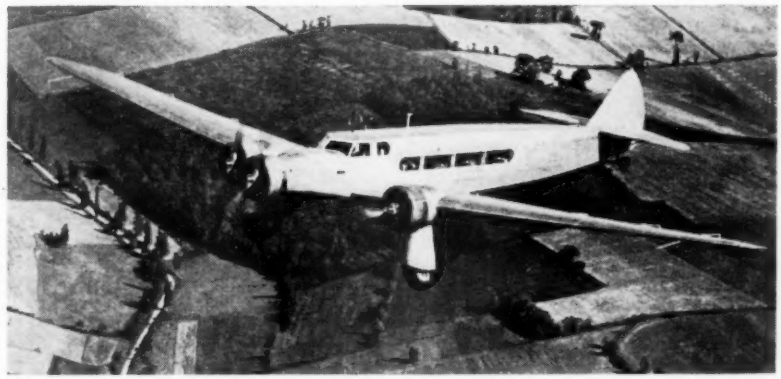
The new French tri-motor transport plane is giving Europe a new mark to shoot at. On her trial trip the Dewoitine D-332, broke four world's records for long distance weight carrying flights.

WITH the launching of the new Dewoitine "Emerald" (D-332), the French airplane designers have at last succeeded in producing a high-speed transport to rival the fast American transport ships that have been the despair of every constructor in Europe ever since Swissair brought over a flight of Lockheed Vegas that outraced everything on the European air lanes.

The new Dewoitine, however, is more than the rival of American planes. It actually goes them one better and is a warning to the Boeings and Lockheeds to look out for their laurels. On her trial flight the new machine, which is a three-motored giant with seats for ten passengers beside the two pilots, cracked four world's long distance records in a single flight, cutting the time for one of the records nearly in half. She is the fastest thing on the European airways, and Aeropostale and Orient Arrow, two of the leading European airlines have already placed orders for trial machines for use on their lines.

The new giant is an all-metal monoplane of cantilever construction—a vivid green in color. The whole structure is built up on duralumin tubes. The cabin is fitted with the most modern equipment, the seats being so arranged that they become couches for passengers to sleep on during night flights. Some of the long flights on European air-lines, particularly on the Orient Arrow line, are now being made entirely at night.

The motor assembly is built up on a structure of welded chrome-nickel-steel tubes. The central motor is at the front of the fuselage; the other two motors in independent nacelles, each placed over one wheel of the landing-gear assembly. All motors are easily reachable through a passage in the wing. These motors are Hispano-Suiza 9V's, nine-cylinder air-cooled radial motors with a normal horsepower of 575 each.



The Dewoitine "Emerald" (or D-332) in flight is an imposing ship. She has a radius of action of 1281 miles carrying full load and has a total weight of 20,607 pounds.

All three engines have been provided with special sound-proof installations and one can carry on an ordinary conversation inside the cabin of the new transport giant. The plane is fully equipped with radio instruments, flares and earth-inductor compass.

The Emerald is a true giant of the skyways, 62½ feet long, 93 feet wing-spread, and stands 18 feet off the ground. Her dead weight is 11,637 pounds, and she carried 8970 pounds of mobile load of which 5849 pounds is fuel and oil when she is fully loaded, giving a useful load of 3121 pounds with all tanks full and more if additional weight is desired at the expense of cutting down her radius of action by decreasing the fuel supply.

This totals up to a full weight of 20,607 pounds, over ten tons, an enormous weight to hurl through the air at the speed she attains. With full load, it is revealed, she has a radius of action of 1281 miles, enough to carry her from Paris to Istanbul.

With full load and fuel capacity she cracked out a speed of slightly over 183 miles an hour in the hands of Marcel Doret, the Dewoitine test pilot, at Villacoublay, and attained a ceiling of over 20,000 feet. These results were so good that Doret decided to go gunning for world's records, and taking aboard a total load of over 2000 kilograms (4409 pounds) he proceeded to try for new records. In a single flight he knocked off four of them, as follows:

Record over 1000 kilometers (610 miles) with 2000 kilograms of load: Old record, 136 miles an hour, Doret's record, 158 miles an hour (a wonderful speed for so long a distance flight).

Record over 2000 kilometers (1220 miles) with 500 kilograms of load: Old record, 139 miles an hour, Doret's record, 154 miles an hour.

Record over 2000 kilometers with 1000 kilograms of load: Old record, 139 miles an hour, Doret's record, 154 miles an hour.

Record over 2000 kilometers with 2000 kilograms load: Old record, 92 miles an hour, Doret's record, 154 miles an hour.

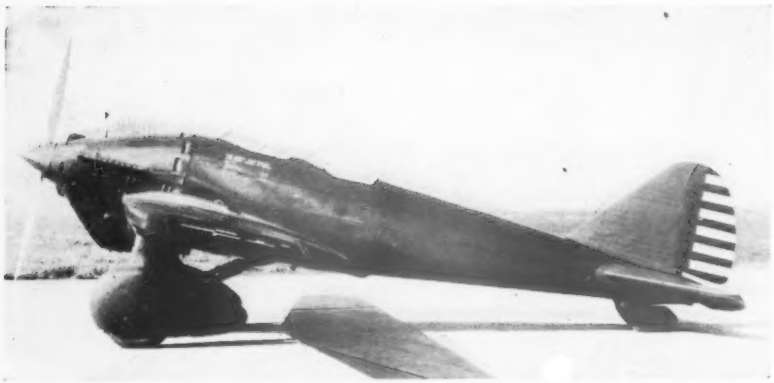
So far as we are aware, no similar attempt has been made by American ships to compete under these given conditions, but we feel confident that the new Lockheed "Electra" could make an excellent showing in such a contest. Very few trials have been made with transports under F. A. I. conditions.

This is just one more example of the European tendency toward tri-motors transport planes which is contrary to the leaning of Americans toward bi-motor types. But in regard to the engines it is interesting to note the disposal of the two wing engines and the reduction of frontal area that is obtained by imbedding the engine nacelles into the "pants" as well as into the wing.

The nose engine of the Dewoitine D-332 projects forward far ahead of the wings, thus giving a comparatively large forward baggage space. It is an all-metal ship of the cantilever wing type that has shown unusually good performance.

How Uncle Sam Stands

by
E. STANTON BROWN
Aeronautic statistician and authority on airplane operation and maintenance.



The new Fokker XA-7 which promises excellent performance but which is still on the experimental list.

SCREAMING headlines! "Air Mail Contracts Cancelled!"—"Army Air Corps to Carry Mail!"

Without any proper investigation of its ability to fulfill the assignment, the Army Air Corps was thrust into the job by swivel-chair politicians and blundering army men with little or no knowledge of it and little liking for it. Major-General Benjamin D. Foulois, chief of the air corps and one of the finest chiefs it has ever had, *first learned of his task through the newspapers*, not through official channels.

The Army Air Corps stepped into the gap and the result was that our fighting ships, which should be the swiftest and staunchest of all planes, faltered and fell, crushed, maimed or killed 12 percent. of the men that flew them. Politics battered to pieces the finest airmail service in the world and destroyed public confidence.

Aside from all consideration of whether or not the cancellations were justified, or the Air Corps should have been used, by far the most important and valuable outcome of the army's deplorable performance was the searchlight beam of publicity thrown on the condition of our air service. The public, and in particular the air-minded public, stunned and aghast at the miserable failure and carnage that resulted in the emergency use of our Army Air Corps which, it has been boasted was second to none, demanded to know WHY?

Let us face the facts squarely and sift through the mass, or rather *mess*, of information and misinformation that has come out in the press and through investigations and ascertain, as closely as possible, the condition of the Air Corps and how it stands in respect to our national defense and the air forces of other nations.

General MacArthur, Army Chief of Staff, *and who is Foulois' superior*, stated, when the job was thrust on the army, that he had between 1600 and 1700 planes of which some 800 or 900 observation and cargo planes and 135 swift bombers were capable of carrying the mail.

When the call for planes went out, it was revealed that Mitchell Field, New York City's single air defense base, had only 36 planes assigned to it, of which but 11 were serviceable in case of war. Only two had speeds approaching our commercial planes' speeds. Twelve planes were out of commission permanently because of lack of funds to recondition them. The remaining 13 planes were either too slow or not in condition to fly the mail, to do night or heavy weather flying. *And that is the air defense supplied to the largest city in the United States, the second largest city in the world, by the wealthiest nation on earth.*

This condition is by no means confined to Mitchell Field. The House Military Affairs Committee investigation revealed that actually only 300 to 400 planes could be mustered by the Army Air Corps in an emergency. Later, General MacArthur, when pinned down by the Senate subcommittee on army appropriations in regard to the army flying the mail, stated that in many cases small pursuit ships had to be used which held so little mail (100 lbs. to be exact) that as many as six planes at a time had to be sent on a flight. It is significant to note that the Army was able to muster only 147 planes capable of carrying mail, which resulted in the cutting down of our airmail route mileage from 27,000 miles to 11,108 miles when the Army began operations.

With these irrefutable facts before the world, Representative McSwain introduced a bill into the House to add 3,034 planes to our Army Air Corps. The House of Representatives, which

TABLE I

LEADING WARPLANE ENGINES COMPARED ACCORDING TO THE ACTUAL POWER THEY DEVELOP AT WAR-SERVICE ALTITUDES—1933

Place of U. S. A.	H.P.	Countries ahead of U. S. A.	Type applicable to	War-Service altitude in feet	U. S. Deficiency in power of wartime engines	
					Measured in H.P.	Measured in %
3rd	400-450 H.P.	France Grt. Britain	Small Fighters	15,000 to 20,000	—150 H.P.	—33.33%
4th	500-550 H.P.	Grt. Britain Japan France	Fighters	15,000 to 20,000	—175 H.P.	—29.17%
3rd	600-650 H.P.	Grt. Britain France Japan Italy	Fighters and Bombers	15,000 to 20,000	—150 H.P.	—21.43%
6th	700-900 H.P.	Grt. Britain France Japan Italy Czechoslovakia	Heavy duty	6,000 to 15,000	—225 H.P.	—25%
We have none of this type	900-1000 H.P.	Czechoslovakia France Grt. Britain Italy Japan	Heavy duty		—1100 H.P.	—100%
4th	1000 H.P. and up	Italy Grt. Britain France Japan	For racing planes		—1650 H.P.	—56.9%
5th	Diesel Engines. 600 H.P. Hisso-Clerget 14J.....France 550 H.P. Rolls-Royce "Condor".....Great Britain 225 H.P. Packard.....U. S. A. Applicable to all types of fighting planes.					

As a Military Air Power

THE tragic accidents connected with the Army Airmail carrying episode, has opened up many facts concerning the inferiority of our air-service compared with those of other major nations. Mr. Brown presents some highly informative performance tables which will be of interest to all of our readers.

has been a direct cause of the starving of our Air Corps ever since the war, practically ignored this bill.

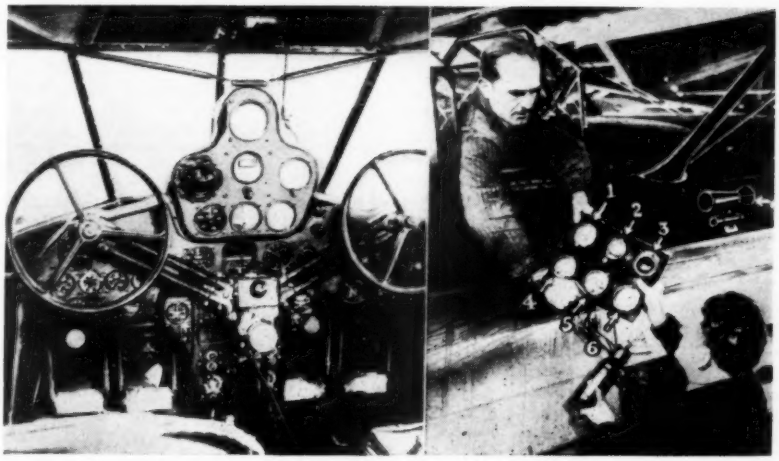
Actual tests showed that our supposedly swift fighting planes could not in any way compete with commercial planes and could not maintain the schedules practiced on our commercial airlines. The comparisons (Table A—next page) were made by actual test mailings from the air hub of the United States—Chicago. The variance of 3 to 9½ hours within the commercial schedules and 10½ to 38 hours within the army schedules is accounted for by the time of mailing.

Four days after the Army began flying the mail, Major C. L. Tinker, commander of the Army's western division of airmail service, stated: "We are faced with an almost impossible task and we can only do the best we can in carrying the mails. . . . The army pilot is accustomed to bombing, to flying in formation, to fighting other ships in the air, to observation, pursuit and attack. Often that training takes ten or twenty years, but it bears no relation to flying over a fixed route."

Major Tinker's statement not only mirrors the conditions of the Army's equipment but it reflects as well the inadequacy and poor quality of training meted out to our Army flyers. If it takes from ten to twenty years for an Army pilot to become proficient in only the direct military applications of his craft, there is something radically wrong somewhere. Medical and psychological authorities state that a fighting pilot is no good in his profession after that period of time.

If some of the duties of the Air Corps bear "no relation to flying over a fixed route," then George Washington was a Chinese magistrate. Just how, might I ask, is a bombing squadron, with its protecting flights of pursuit ships, going to reach its objective one-hundred or more miles away, and flying at night, without knowing how to fly a fixed route? Furthermore, in case our air forces should have to be concentrated, or if a national emergency should arise, just how are the ships to get from any distant point to the point of concentration?

Since military flying "bears no relation to flying over a fixed route," perhaps they would knock the planes down and ship them by rail and the war



LEFT. The complete blind-flying and navigational equipment provided on a modern mailplane. RIGHT. The inadequate instruments formerly provided on Army Air Corps ships had much to do with the Army's failure as a postman.

TABLE II

ARMY FIGHTERS, PURSUIT, SINGLE-PLACE—WAR-SERVICE ALTITUDE 15,000 to 20,000 ft.

Position	Country	Type	Speed m.p.h.	U. S. deficiency in speed at War-Service Altitude: Measured in m.p.h.	Measured in percentage
1	Great Britain	Hawker "Super-Fury" Vickers "Jockey"	250 238		
2	France	Dewoitine 500	215		
3	Poland	P.Z.L.P.XI.	205		
3	Italy	Fiat C. R. 30	205		
4	Japan*	Kawasaki 92	200		
5	Sweden	Svenska "Jaktfolk"	200		
6	U. S. A.	Curtiss XP-934 Boeing P. 26	195 185	—55 m.p.h. —65 m.p.h.	—22% —26%

ARMY FIGHTERS, MULTIPLACE—WAR-SERVICE ALTITUDE 15,000 to 20,000 ft.

1	Great Britain	Hawker "Demon"	205		
2	France	Breguet 41 M 3	195		
3	Japan†	Junkers K-47	180		
4	Switzerland	Dornier Do. C4.	175		
5	U. S. A.	Berliner-Joyce P. 16	160	—45 m.p.h.	—21 95%

ARMY FIGHTER BOMBERS—WAR-SERVICE ALTITUDE 15,000 ft.

1	Great Britain	Vickers B. 19/27	180		
2	U. S. A.	Martin YB-10, 12, 13, 123 Boeing B-9	170 170	—10 m.p.h. —10 m.p.h.	—5.56% —5.56%
2	France	Amiot 141 M	170		
3	Japan‡	Junkers K-37	165		
4	Czechoslovakia	Aero A. 42	160		

ARMY HEAVY BOMBERS—TROOP TRANSPORTS WAR-SERVICE ALTITUDE 15,000 ft.

1	Great Britain	Fairey	175		
2	Japan‖	Junkers K-51	160		
2	Italy	Caproni 95	160		
3	France	Liore et Olivier "Le O" 206	140		
4	U. S. A.¶	Keystone B-6A	100	—75 m.p.h.	—42.86%

*Japan is licensed to manufacture "Hawker" and "Nieuport-Delage" warplanes.
†Japan is licensed to manufacture "Hawker", "Breguet", "Junkers" and "Dornier" warplanes.
‡Japan is licensed to manufacture "Junkers" warplanes.
‖Japan is licensed to manufacture "Junkers" and "Dornier" warplanes.
¶Note: U. S. Army heavy bomber has been superseded by the Fighter Bomber.

might be over by the time they arrived, much to our regret.

During the World War, the importance of night flying and careful cross-country navigation to an objective was definitely proved. The lessons taught then seem to have been totally ignored in the training and routine flying of our military pilots. Ten hours blind-flying and twenty hours night flying is stipulated in the training course of our flying cadets. Last year only 7 percent. of the army's total flying was done at night. It would be interesting to know if the night flying done by the flying cadets was counted into this 7 percent.

There is a strict ban on night flying in the army except with special permission. This ban was lifted to permit the army pilots to suddenly plunge into the darkness with mail loads. Before February nineteenth, an army pilot overtaken by darkness had to land and wait for sunrise.

On February 16, the following message came over the Department of Commerce Teletype system, which highly amused commercial pilots: "Chicago —Lieut. Partridge, army air corps mail operations, held over by darkness at Terre Haute. Leaving tomorrow with Lieut. Lay as passenger." *This*, in spite of the fact that there is a lighted airway from Terre Haute to Chicago over which American Airways' planes fly nightly. Perhaps the enemy would stop all air operations at sundown to suit the convenience of our air corps!

The House of Representatives put the finishing touches on the tragic burlesque on February 24. After 6 army pilots had lost their lives because of their lack of night flying experience and their inability to fly blind, the House passed the administration's temporary airmail bill, authorizing the army to fly the mails for a year, thus plunging our poorly trained men still deeper into the mess.

Because of this action 6 more pilots of the Air Corps plunged to their deaths and 3 more were injured, bringing the total to 12 dead and 5 injured by March 30. Forced landings and cancelled flights continued to be the rule rather than the exception and the President was finally forced to call a halt to the army carrying the mail until things could be gone over carefully and the service reorganized. When operations began again only 25 percent. of the original routes were being flown.

* * *

OUR Army Air Corps, composed of as fine a group of men for courage and intelligence as there is in any service in the world, has labored consistently under the handicaps imposed on it by the official stupidity and swivel-chair idiocy of Congress, and the stolid prejudice, jealousy, officiousness and narrowmindedness of the stick-in-the-mud high ranking officers of the other branches of our Regular Army.

Regular Army Air Corps pilots are permitted only ten hours in the air per

(*Continued on page* 404)

TABLE A.
Comparison Between Commercial and Army Mail Schedules

Deliveries	Commercial	Army
Chicago to New York	12½ to 20½ hours	15 to 36½ hours
Chicago to Salt Lake City	22½ to 25½ hours	24½ to 43½ hours
Chicago to Seattle	16½ to 38 hours	54½ to 92½ hours
Chicago to Dallas	16½ to 33½ hours	17½ to 39½ hours
Chicago to Washington	11½ to 20 hours	20 to 39 hours

TABLE III
COMPARATIVE PERFORMANCES OF WARPLANES AT VARIOUS ALTITUDES

GROUP A: ARMY FIGHTERS—SINGLE-PLACE

Country	Type of Warplane	Max. Speed m.p.h.	Max. Speed at ft.	Speed at 10,000 ft.	Speed at 15,000 ft.	Speed at 20,000 ft.	Climb to 15,000 ft. (minutes)	War-Service ceiling
Great Britain	Vickers "Jockey"	238	20,000	225	238	238	7	36,000
	Hawker "Super-Fury"	250	13,000	245	250	245	7	35,000
	Fairey "Firefly II"	223	13,000	225	230	225	8	35,000
	Gloster S.S. 19	205	10,000	205	205	195	8	35,000
	Armstrong-Whitworth XVI	205	10,000	205	200	192	9	35,000
	D.H. 77	203	10,000	203	195	195	9	32,000
France	Dewoitine 500	230	15,000	220	230	215	8	35,000
	Nieuport-Delage 121C-1	229	11,500	228	225	220	6	39,600
	Loire 43C-1	223	10,500	224	221	215	8	35,000
	Mureaux 170C-1	225	12,000	227	220	215	8	33,000
	Morane-Saulnier 325	225	13,000	220	225	210	8	36,000
Poland	P.Z.L.P.XI	217	13,200	217	215	205	6	33,000
	P.Z.L.P.VIII	206	12,040	210	200	190	7	30,000
Italy	Fiat C.R. 30	224	10,000	224	214	205	8	30,000
Japan	Kawasaki 92 (K.D. 5)	217	5,000	210	205	200	6	32,000
	Nakajima 91	190	10,000	190	185	180	8	30,000
Sweden	Svenska "Jaktfolk"	208	13,000	205	205	195	9	32,000
U. S. A.	Curtiss "Swift" XP-934	215	6,000	205	195	185	8	30,000
	Curtiss "Hawk" P-6E	197	5,000	189	182	175	9	26,500
	Boeing P. 26	210	6,000	205	195	185	8	30,000
	Boeing P. 12E	189	6,000	187	180	173	10	28,000

GROUP B: ARMY FIGHTERS—MULTIPLACE

Great Britain	Hawker "Demon"	210	13,000	210	210	205	8	35,000
	Fairey "Fox II"	210	13,000	210	210	205	8	35,000
France	Breguet 41 M 3	195	15,000	200	195	190	11	31,350
Japan	Junkers K-47	192	13,000	200	190	180	9	33,000
Switzerland	Dornier Do. C4	197	11,500	200	190	180	12	31,150
U. S. A.	Berliner-Joyce P. 16	186	6,000	180	170	160	12	26,200
	Curtiss "Shrike" A8	197	Ground	180	170	165	20	19,800

GROUP C: ARMY OBSERVATION—GENERAL PURPOSE PLANES

Great Britain	Hawker "Audax", "Hart"	210	13,000	210	210	210	8	35,000
	Westland "Wallace"	190	12,000	190	185	180	10	35,000
	Armstrong-Whitworth "Atlas II"	175	10,000	175	170	165	10	32,000
	Fairey "Gordon"	180	10,000	180	175	170	10	32,000
	Vickers "Vespa"	180	6,500	175	170	165	9	32,000
	Bristol 118	175	12,000	175	170	165	10	32,000
Belgium	Renard R 31	208	13,000	210	205	200	10	34,000
France	Mureaux 112 R.2	192	16,500	200	195	190	8	35,000
	Breguet 27-3	200	13,500	200	200	180	11	30,000
	Potez 50 A-2	192	6,500	192	185	180	8	31,000
	Latecoere 49	171	13,500	170	165	160	13	26,500
Japan	Kawasaki 88	160	10,000	160	155	150	12	27,000
U. S. A.	Curtiss "Raven" Y10-40A	195	6,000	192	187	175	10	26,000
	Consolidated 23	192	5,500	190	180	170	10	25,000
	Douglass O-38S	172	5,000	170	165	155	12	21,500
	Thomas-Morse O-19E	158	5,000	150	145	140	15	21,000

GROUP D: ARMY FIGHTER BOMBERS

Country	Type of Warplane	Wt. Loaded (pounds)	Power Loading (lbs. per HP)	Max. Speed m.p.h.	Max. Speed at ft.	Speed m.p.h.	War-Service ceiling
Great Britain	Vickers B.19/27	16,400	13.7	195	10,000	180	27,000
	Boulton and Paul "Sidestrand III"	10,200	10 2	160	20,000	170	30,000
U. S. A.	Martin YB-10, 12, 13, (123)	12,200	10.4	195	6,000	170	25,000
	Boeing B-9	13,500	10.3	185	6,000	170	22,600
France	Amiot 141 M	15,070	10.8	180	10,000	170	26,000
	S.E.C.M. 141 M	14,236	10.2	161	10,000	155	23,700
	S.P.C.A. 30 M 4	14,300	11.0	158	10,000	150	24,600
Japan	Junkers K-37	9,500	9.5	169	13,500	165	27,000
Czechoslovakia	Aero A.42	10,428	10.4	168	10,000	160	22,000

Buffeting and Its Effects

by LAWRENCE LESH

Aeronautic engineers have known for a long time that stresses on the tail group increased enormously on transport ships whenever the size exceeded certain limits. This difficulty is now attributed to "buffeting" due to the action of the air-stream.

DID you ever try to stand up in the full blast of an airplane propeller?

If you have, then imagine that blast to be controlled by a terrific force twisting it into unpredictable cyclones and you have some idea of the destructive blows beating against the tail of a high speed airplane.

Like a giant hammer, these whirling masses of air with a velocity twice that of a hurricane capable of lifting the roof of a house, batter the finely attuned surfaces which guide the ship through the air. Just so long as things go as the designer intended, the lightest touch of the pilot's hand is master of the hurricane, but if not—

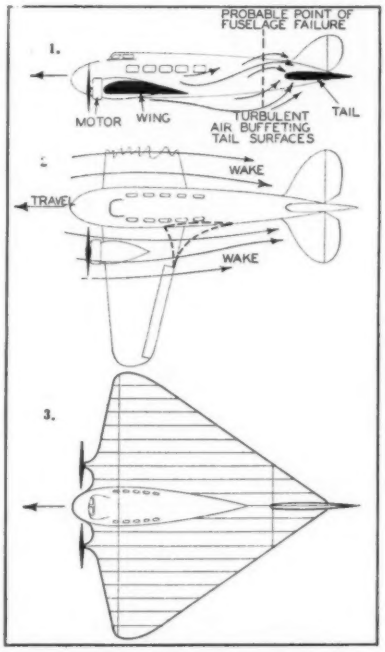
"AIRLINER CRASHES KILLING TEN"

Change this headline one way or another and you have the sad story, never completed, of the typical crash. Investigators rush to the scene and carefully examine the wreck. Survivors, if any, relate incoherently their impressions of what happened. Engineers responsible for the design insist that structural failure was impossible and produce calculations and tests (made on terra firma) to prove that the machine could stand strains twenty times as severe as encountered in flight. Yet—after the accident in which the beloved Rockne was killed, a whole fleet of planes was grounded while changes were made to eliminate weakness.

"Wing flutter—tail flutter," were the words whispered by pilots and engineers. Tests with models and then with full sized machines were conducted. Sometimes the machine would "flutt" as expected. Other times it would refuse to misbehave. Dynamically balanced control surfaces were found to apparently cure the trouble and engineers proceeded to build larger and faster machines confident that they would not "shimmy."

They didn't. They did something a whole lot worse—collapsed. Not at first during the test flights, even under the worst possible conditions nor necessarily early in their career but at the most unexpected moment in regular service something happened to certain of these ships and they went down. Other airplanes of the same or different design might fly for years without structural failure.

The reason why airplanes crash in this fashion is known but no amount of calculation or test will definitely produce an airplane of the types flying today, fundamentally free from the danger of structural failure. Obviously, airplanes of certain definite design flown for ten years or so without a recorded case of failure may be classed as safe but long before the ten years is up such an airplane is obsolete on account of inferior speed and is then supplanted by new designs which may incorporate the deadly unknown quantity. Just what is this unknown quantity, why is it hushed up in a conspiracy of silence and how will it be overcome in the future? Let us see.



(1) Conventional airliner type that has frequently been the victim of buffeting. The disturbed air behind the wings may batter the tail until it breaks off. (2) Compromise streamlining (shown dotted) known as skirting, may reduce buffeting. (3) Bat form flying wing in which buffeting is eliminated: patents of Wm. B. Stout, Wojedvosky, Kucher, Snyder and Lesh.

The engineers have a word for it—"buffeting." A word full of meaning and apprehension for them but not sounding very dangerous to the average reader. Wing and tail flutter, or "shimmy," the troubles which beset the airplane designer a few years ago, are more alarming to the layman who associates such effects with the sometimes erratic action of the front wheels of automobiles.

Buffeting, as the name implies, describes the action of the disturbed wake of air (behind an airplane) on the tail surfaces. The turbulent masses of air strike the tail very much in the same manner as the watery trail behind a speedboat affects a surfboard although the action by comparison is much more violent and erratic. The blast of the propellers may smooth out this turbulence to a degree but, in the most important of flying maneuvers, the landing, the propellers are turning slowly and have little effect. In a steep climb or other maneuver approaching the stalling angle of the wings, buffeting becomes more violent. In a sideslip, which is sometimes necessary in case of a forced landing, the danger is increased.

The reader will naturally inquire why the tail is not made sufficiently strong to overcome any possibility of its breaking away. There are two reasons why this is difficult. First, a heavy tail is no bargain on an airplane for a variety of reasons, one of which is that it may mean exposing still more surface to the action of the turbulent wake and, secondly, if the rigidity of the fuselage and tail is carried beyond a certain point it may be tuned to the buffeting at certain speeds and vibrate like a wire or flat strip exposed to the wind.

If there happens to be the slightest tendency for the tail to flutter by itself, this added resonance will mean destruction. We are all familiar with the fact that a wine glass may be broken into small pieces due to the vibrations produced by a violin bow producing a certain critical note and it is this same principle which controls, within the limits of calculation and experiment, the design of all the parts of an airplane to avoid destruction.

The great trouble is that the action of the tail becomes so complicated as to be unpredictable and any loosening of the parts, unusual action of the motors, or abnormal vagary of air currents may bring about a combination that spells disaster. In one case it appears probable that a gasoline explosion in one wing was enough to disturb the delicate balance of forces so that the whole tail and part of the fuselage of a large airliner broke away completely. If the tail had stayed on the ship might have landed safely.

The designing engineers are silent because they want to keep their jobs or may want jobs in the future and they know what will happen if they tell the truth. Engineers who happen to have designed planes free from buffeting are smart enough not to gloat over it. Their next design, perchance, may prove to have a "rubber tail" so it is better to sit tight and look wise.

Government experts assigned to test and approve airplanes have put their stamp of approval on whole fleets of planes, now or formerly in use, many

of which have provided crash headlines. They knew what was wrong—after the accidents happened. They are doing their best to guess whether machines are safe and are only to be condemned for concealing the truth which, if told, would get them into trouble. The newspapers of the country are very apt to publish the truth but the facts disclosed herewith have never been clearly placed before them.

How may airplanes be made safe from breakage in flight? Only by a radical but logical change from present wing design. Buffeting is the result of violently disturbing the flow of air as it proceeds under the wings and back to the tail surfaces. If this flow is even and continuous the danger is eliminated and the result may be accomplished by properly streamlining to create this even flow. Experiments to overcome buffeting by "fairing" or filleting the space between the wings and the fuselage and thus establishing a fair continuity were first made in Continental Europe, later taken up energetically in England and finally in the United States. So far, the designs have been merely a compromise with the conventional airplane as we know it but the results have been well worth while.

Fairing or "wing fillets," as they are sometimes called, have been applied to low-wing monoplanes but unfortunately it is impossible to realize the full advantages with this type of construction. A complete expression of the true principle was incorporated in the "Batwing" built by William Stout, later designer of the Ford planes.

Several "Batwings" were built and flown, one being the first all-metal airplane built in this country. Years ahead of his time, Stout reluctantly dropped back to conventional design in order to achieve a quick commercial success in which he was not to be disappointed but he is still a firm believer in the "Batwing" or true flying wing.

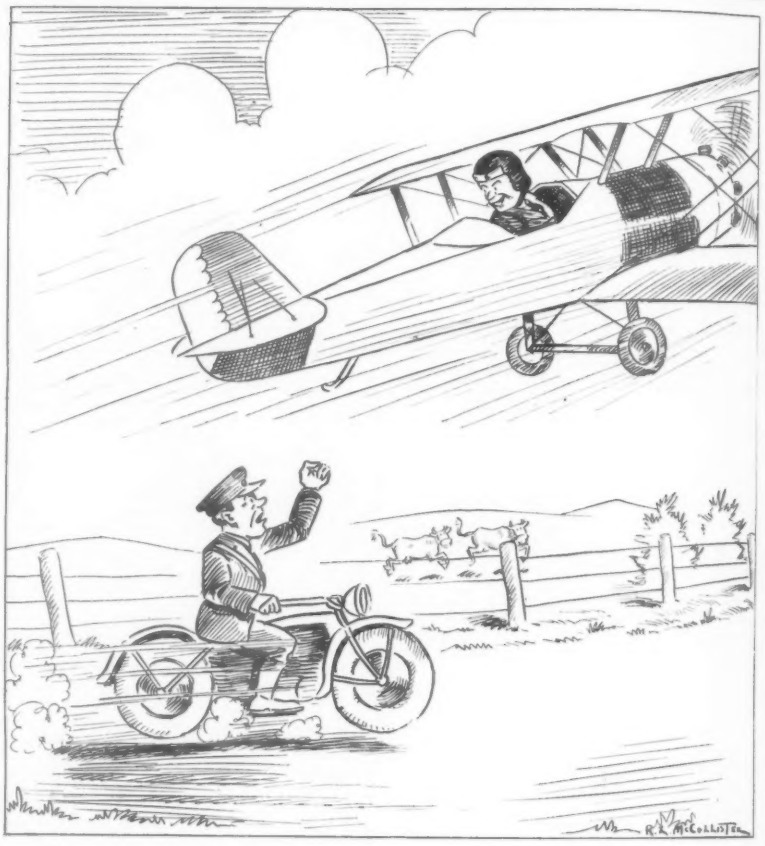
The flying wing built by Doctor Snyder of South Bend, known as The Arup, has built up many hours of regular flying in the air, demonstrating its ability to do everything the conventional airplane will do with absolutely no possibility of a major structural failure. In the flying wing, the tail or rudder elements are really integrated with the wing and all possibility of "wobble" or losing these important organs of flight control is eliminated.

The future of the flying wing and aviation, safe from the possibility of collapse in flight, is entirely up to the public interested in flying. Millions of dollars are tied up in airplanes of the conventional and essentially dangerous type. Manufacturers and airline operators will resist change to the last ditch, partly through ignorance and partly on account of hesitancy to make radical changes in present design involving developmental costs.

In the meantime the flying wing waits.

The Forgotten Birdman Gets It Again!

by KEN SINCLAIR



AMATEUR flyers in Washington State, just recovering from their indignation over the arrest and conviction of Ross Peters, garage mechanic, who dared to fly in a home-built single-place unlicensed Lincoln Sport job, are finding out that they "ain't seen nothing yet."

The authorities, having gotten away with the Peters case—Ross was sent to jail at the instigation of one Donald Graham, "State Governor" of the N.A.A.—have cracked down for sure this time, and the forgotten airmen are still reeling from the blow.

State Highway Patrolman George Fisher—"former World War flyer and transport pilot," who has been confining his flying talents to the handlebars of a motorcycle for lo! these many years—cruised into the southern part of the state recently and grounded fifteen hapless flyers of unlicensed ships in one week.

Encouraged by his success, he dusted off his uniform, polished up his boots, greased his deadly automatic and stuck his "transport license" in his hip pocket. Whereupon, he piloted the state's motorcycle northward into King County, the most populous in the state—where amateur pilots are thicker and the hunting ought to be better.

Meanwhile Capt. Loren G. Ray, King County chief of the motorcycle-pushers, blossomed forth with the benign announcement that the anti-private-flyer aviation law, enacted by the legislature in the balmy days (take them words whichever way you choose, brethren!) of '29 but never enforced until now, will be rigidly adhered to from now on.

The state law provides that all ships must be licensed by the U. S. Department of Commerce before they can be considered worthy of Washington's sky, no matter what the ships are to be used for. Naturally, that bars the lightplane builder from the sky, since it is practically impossible for him to license a home-built job. And, should an amateur dare to take a pleasure hop alone, he courts a $500 fine and perhaps imprisonment.

Enraged lightplane sharks, astonished that the Highway Patrol's motorcycle artists, after these years of blissful ignorance of the aviation law, should suddenly jump into singular activity and determination to sweep the amateur sport flyer from the skies, are in a flat spin, figuratively speaking.

They point out the sad fact that Washington's automobile accident toll has been mounting steadily for years,

(*Concluded on page* 399)

A French Aviation Museum

by HELEN S. WATERHOUSE

A private collector of aeronautical specimens in France has established one of the most remarkable museums in the world. This is well worthy of being duplicated in this country.

THE first museum in the world, devoted exclusively to aviation, is at Chalais Meudon, near Paris, France.

Its founder and present manager is Charles E. Dolfuss, famous sportsman balloon pilot. This man who crossed the Atlantic on the last Graf Zeppelin trip to this country, was later to be badly injured in the crash of the Dimaxion experimental automobile at the World's Fair last summer.

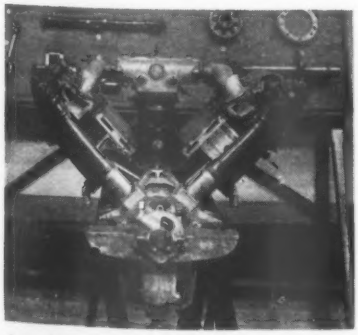
It was while in this country, recuperating from the effects of the crash at the home of his rival balloon pilot in many a Gordon Bennett race, Ward T. Van Orman, that Mr. Dolfuss described his Museé de L'Aeronautique in detail.

"My museum is really a childhood's dream come true," he stated. "As a boy of seven in Paris, I became interested in the Santos Dumont flights. At 10, I began a private collection of aviation treasures in earnest and have kept up that collection through the years.

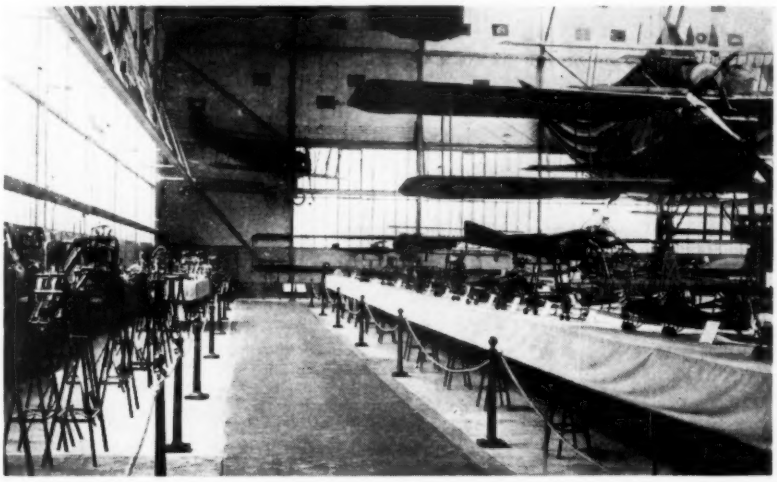
"One week after the armistice was signed, together with two men who were working in the technical aviation service of the French government, I set out to gather things for a real aviation museum.

"We scoured Europe for airplane motors of bygone days and for old-time flying machines. We dug many of them up from pre-war flying fields and salvaged others from junk piles. Many were valuable as obsolete models. We also collected old wood cuts and prints of early balloon ascensions.

"We assembled everything in a large hall in Chalais Meudon and since that time, aviation enthusiasts from all over the world have made pilgrimages to the museum. We are constantly in touch with aviation people in all parts of the world, procuring new treasures and frequently we exchange things with other museums. Recently, the French government suggested that we move the museum to Paris where more people would have access to it and this may be done later."



A sectionalized Hispano-Suiza aviation engine on exhibition at the museum. A board carrying the component parts is shown in the background.



A view down one of the aisles in the Museé de L'Aeronautic which gives an idea of the tremendous amount of diversified aeronautic material that has been collected.

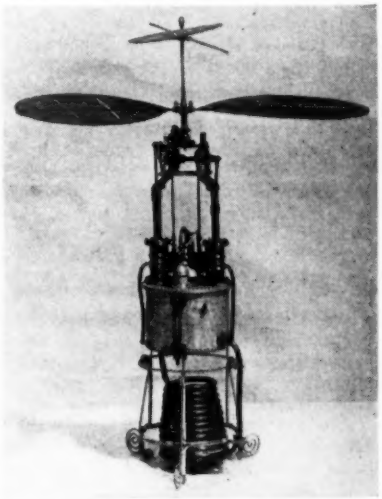
The original airplane, "Demoiselle", is the outstanding treasure of the museum, according to Mr. Dolfuss. The first seaplane ever to take off successfully from the water, and two ships which have made transatlantic crossings, are also here. The "father" of all racing machines, a monoplane built in 1912, the first fast machine ever to take to the air is included in the collection.

Cars and baskets of the very first airships ever built, form one interesting display. This collection includes a queer boat-shaped basket, built for his rocket-shaped airship by Dupuy de Lome in 1873, the propellers of which were worked by hand by the eight men in the basket. There is also the basket of Renaud's airship, which was the first lighter-than-air-craft to perform a complete circuit in the year 1884.

When Mr. Dolfuss is not busy with his museum and collecting, he is editing a French aeronautical magazine, and taking trips about France in his little balloon.

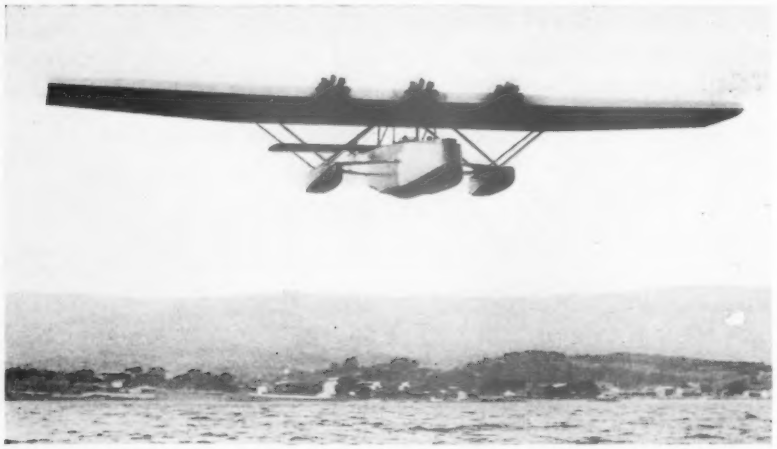
All over America are similar relics stowed away in haymows, wood-sheds and basements that have played their part in the development of American aviation and which well deserve to be given a permanent show place in this country. That this is possible was proved last year by the Air Show, Century of Progress exhibition in Chicago where a multitude of old-timers were on display. This should be done before many years pass, for trophies of this sort are not improved by temporary and unprotected storage.

It has been suggested that such material be given an appropriate resting place in the new Rosenwald Industrial Museum of Chicago, and while this matter has been taken up with the management no active steps have yet been taken toward the accumulation of aeronautical exhibits. The original Langley Aerodrome reposes in the Smithsonian Institution, Washington, D. C., while the first Wright plane is in England. It would seem desirable to have such historical relics concentrated in one museum but whether this can be accomplished or not is yet to be seen.



This is a replica model of the steam driven helicopter model designed and built by Ponton d'Amecourt in 1863. This is the granddaddy of the direct lift machines.

France Has a New Tri-Motor Seaplane



The French S. P. C. A. Tri-motor seaplane in flight, a new and speedy all-metal craft showing excellent heavy-weather ability.

ONE of the most remarkable machines brought out by a European factory this year is the new French S. P. C. A. seaplane, E5, a big three-motored craft of high speed, extraordinary carrying capacity, high ceiling and especially rapid take-off from the water.

She is of all metal construction and tests of the ship off Marseilles show her to be a wonderful heavy-weather boat, as she took off and landed without difficulty or damage in a storm with high seas running that would have swamped the ordinary seaplane.

Her heavy-weather stability and other characteristics are due to the determination of the designers to fly in the face of the general European tendency to make refinements in design, and to sacrifice every other consideration to stoutness and serviceability. As a result they have obtained a ship that not only comes up to requirements in this direction, but also has better performance than many more refined craft.

The single cantilever-section monoplane wing is covered with dural as are the hull and floats. All other parts, including the triangular bracing, are composed of the best grade of high-speed steel, an expensive procedure, but one that has justified itself in practice, as it gives the machine an unusual durability and strength.

The huge wing, over 11 feet chord, has practically no taper toward the tips and comes off blunt at the ends in sharp distinction to normal European wing design. The nacelles for the three motors, as well as oil and gas tanks, pumps, magnetos and other motor accessories are located in this wing, which is also provided with a "corridor" communicating with a trap-door in its lower surface. By means of this corridor and trap-door it is possible for mechanics to step out of the hull, climb into the wing and effect motor repairs and adjustments at any time while the machine is in flight, a set of adjustable steps attaching to the struts making the climb possible without danger.

The bracing of the motors also forms part of the cantilever wing structure and like all but the outer surfaces of the machine, is in high-speed steel. By means of the interior-wing "corridor" it is even possible for the mechanic to follow the aileron control lines inside the wing while the machine is in flight, and clear jammed or damaged ailerons —an altogether original piece of design.

Other interesting and unusual features of the design are the placement of the floats and motors. The floats are close in on the main hull of the craft instead of at the wing-tips. S. P. C. A. engineers claim that wing-tip floats suffer much damage in heavy seas, due to lack of bracing. Experiments in their laboratories show that the position adopted for the floats not only gives great strength, but decreases parasite resistance on the part of the floats. Stability is assured by the width of the hull and floats, and the careful distribution of weights.

Most European seaplane builders favor placing the motor above the wing on monoplanes, or above and behind it, making the machine a pusher, on account of spray damage to motors and propellers.

The design of the S. P. C. A. E5 makes a sharp break with this tradition also. They are placed at the leading edge and are tractors to give the machine the rapid take-off and quick climb which are its most striking characteristics. The designers acted on the theory that the way to avoid spray was to get the machine off the water and out of the spray as quickly as possible.

Additional protection is provided by locating each motor over a float; the two outer ones over the small floats and the center one over the main hull. The hull itself is very large and deep and extraordinarily roomy; the control

(*Continued on page* 409)

The First Aerial Duel

by GLEN TASSIE

IN recent years there has been some controversy concerning the first aerial duel and the first person to fall in such combat. While browsing in a library, I came across the following account which will, if it does not completely answer the question, at least provide more material for discussion.

In 1808, two Frenchmen, a M. de Grandpré and M. le Pique, had a slight disagreement over a lady which led to an exchange of cards. The two gentlemen, seeking a novel means of settling their dispute, became acquainted with the possibilities of free balloons and agreed to fight in them.

While the combatants nursed their hatred, a month was consumed in making the two balloons exactly similar in both size and weight. When they were completed, the duelists, armed with blunderbusses and accompanied by their seconds, entered the baskets. The ropes were cast off and the fighters arose amid the cheers of the on-lookers.

The intrepid aviators were about one-half mile high and eighty yards apart when the signal to fire was given.

M. le Pique fired—and missed.

M. de Grandpré fired and hit his opponent's balloon with several of the slugs with which the blunderbuss was loaded.

The gas or hot air (which is not stated) escaped from the torn bag, which fell swiftly, killing both M. le Pique and his second—"much to the satisfaction of the spectators."

And there you have it. Is it the first?

It Reduces Expense

INDOOR bombing practice is latest on the curriculum of British army and navy student pilots. The pupil sits in a stationary plane while a motion picture of the ground, supposedly 8,000 feet below, passes under him. When the bomb-release is operated, a recording device marks the exact spot where the bomb would have landed if it had been dropped from the air.

"Tune 'er Up—Mech"

The Licensed Mechanic Goes to Heaven.

Details of the Stinson "Reliant"

Many new features are incorporated in this latest Stinson cabin plane such as speed arrester flaps, gulled wings and refined streamlining at all points.

IN the class with $10,000 cabin-planes, the Stinson Reliant is designed to provide reliable cross-country transportation for the business man or commercial operator at operating costs comparable with motor car travel. It has a quick-take-off, a cruising speed of 120 m.p.r. and is provided with the latest developments in sound-proofing, ventilation and heating.

Among the new features available in the various models of the Stinson Reliant is the "Selectiv Glide" or speed-arrester, which enables the pilot to choose the desirable landing-speed and gliding-angle for clearing high obstacles at the edges of the airports and to come to a complete stop within a very short distance. This device is comparable to the gear-shift in an automobile and can vary the gliding angle from the customary 1:10 to a very sharp angle of descent. It not only checks the speed but maintains the lift during the landing so that danger from stalling is avoided.

Further innovations, incorporated in the design, not previously found in planes listed at the price of the 1934 Reliant, are full low-pressure air-wheels with water-proof disc type hydraulic brakes which not only avoid grabbing but also reduce the trouble and servicing charges by eliminating cables and complicated mechanisms. The landing gear is of the heavy cantilever type with Aerol shock-absorbers without springs.

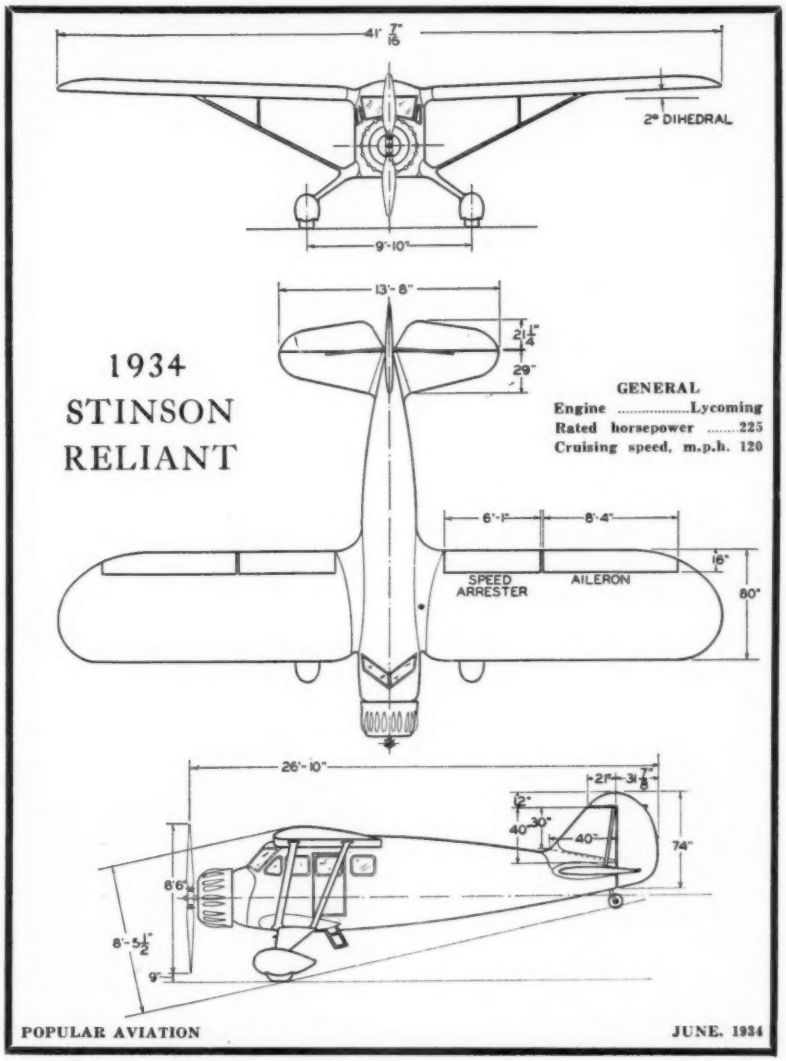
A very modern powerplant is installed consisting of a 225 h.p. Lycoming engine mounted on rubber vibration dampeners. Scintilla magnetos, Stromberg carburetor and an Eclipse electric starter are standard equipment. A 13-plate, 12-volt storage battery provides current for the starter, lights and the many other purposes for which electric current is now employed on a plane.

Reliant wings have been "gulled," the span has been decreased by two feet, while the chord has been correspondingly increased for high speed and efficiency. And, in agreement with the wing improvements and higher speeds, the Reliant has been streamlined to a higher degree than ever before. It has a full NACA speed cowling on the engine with either pants or mud-guards as optional equipment. The wing butts, fin, stabilizer and strut ends are all smoothly filleted in metal.

For the further reduction of resistance and safer vision, a new "V" transport type windshield has been provided. There is also a sun-visor and a rear vision mirror. Safety glass is used throughout for these parts and the windows as well.

(*Concluded on page* 399)

The 1934 Stinson "Reliant" is a trim neat job.



The Development of Rockets

by
FLETCHER PRATT

European correspondent of POPULAR AVIATION *and member of the American Interplanetary Society.*

Reading the record of a rocket motor's performance. This instrument, attached to the rocket, gives a complete record of the combustion. Mr. Pendray (with hat) stands in the foreground.

ONE of these days they are going to wheel a funny-looking plane out of the hangar; possibly a plane without any tail at all, whose fuselage, instead of tapering off will end in a blunt round mouth not far back of the cabin.

Perhaps, on the other hand, it will be a plane with a great tail, all set with vanes, turbines and propellers in a bewildering maze of machinery. In either case, a pilot will let himself in through a manhole and take his seat in a cabin bulging at every corner with shock-absorbers and air cushions. The manhole will be screwed in after him, making the cabin air-tight.

When he has taken his place and turned on the artificial air supply, he will give the stick a preliminary wiggle to test his controls, then press a plunger in front of him—and with the roar of a sixteen-inch cannon and a burst of flame, he will be off at the speed of a bullet—fast enough to circle the earth in five hours—the rocket-plane.

We will have to come to it sooner or later for the long hops, say the scientists. They point out that the most efficient modern steam-engines now develop less than 22 percent. of the kick contained in their fuel. Gasoline engines average a little better—around 27 percent.; and Diesels, when they get to high speeds have an efficiency of about 33 percent. All of them begin gasping for breath at high altitudes, and have to carry heavy superchargers in addition to the great weight of their motors, so that for really long flights, like that across the Atlantic, the pilot cannot consider carrying anything but himself and his fuel.

And as for high speeds, eminent physicists doubt whether any engine can be built that will stand a speed above 780 miles an hour, which is the speed of sound. They point out that at that speed, the effect of the sound vibrations generated by the motor would be very likely to set up other vibrations that would wreck the whole machine in a few seconds.

The fuel in a rocket motor is over 60 percent. efficient at speeds above 600 miles an hour and as the speed goes up, the efficiency increases.

At somewhere around 3,000 miles an hour the efficiency is practically 100 percent., that is, every atom of the fuel produces a forward thrust. This means that the rocket-plane could get by on about a quarter the amount of fuel necessary to drive a gasoline-motored airplane, and the rest of the weight can therefore be put into useful load.

G. Edward Pendray, head of rocket experiments for the American Interplanetary Society and authority on rocket design.

There is no reciprocating nor rotating motor to be racked by vibration; nothing but rigid tubes from the fuel tanks to the explosion chamber. All the weight that now goes into the motor can be put into pay load. And up in the stratosphere, where the ordinary motor is gasping for air, the rocket-motor *gains* 20 percent. more efficiency. As far as the working of its motor is concerned, a rocket-plane could sail to the moon—and probably will some day. And as for military uses—what chance would a bomber or even a fast attack plane have against a rocket pursuit ship dropping onto it from a height of 60,000 feet at a speed of 1100 miles per hour?

The rocket is just another old idea that came back. It was brought to Europe originally by Sir William Congreve, an English general who saw them in the Orient, and to whom it occurred that they might make good military weapons. This was in 1805, and with a corps of rocket-men he managed the English bombardment of Copenhagen in that year with great success. Rocket corps were then established in most armies, but the rapid development of artillery drove them out as inefficient and uneconomical. Meanwhile, however, rockets had attracted the attention of the scientists.

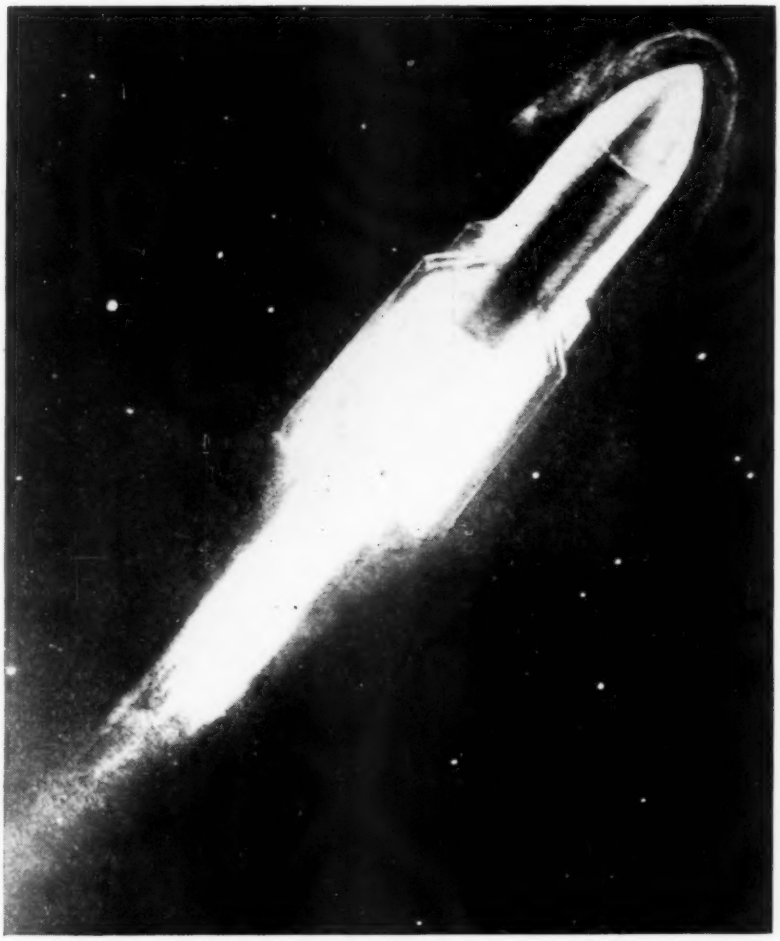
There was some experimenting done on them, but it was in a rather aimless fashion, and the only important experiments were those of Col. Konstantinoff of the Russian army who began fooling around with a rocket glider about 1850. It didn't work and the colonel recorded his opinion that rockets were unreliable at low speeds (which is perfectly true, by the way) and stopped experimenting. After this, the whole rocket idea went to sleep and stayed there for another fifty years, or until about the time of the World War.

Shortly before the war, people really began to talk seriously of undertaking flights to the moon or to some other planet and the rocket idea woke up with a bang. For it became evident at once that if flight through space was ever ac-

for Stratospheric Flights

ROCKET experimentation is proving to be one of the most interesting of pursuits and promises to lead to practical results.

There are two major rocket societies in the United States — the American Interplanetary Society and the Cleveland Rocket Society—which are making substantial progress in the new science.



A repulsor type rocket in flight which is being propelled at a high velocity by liquid fuel. A diagram of this rocket will be found on the following page. This picture is indicative of the high speed and the great energy involved in a rocket flight.

complished, it would take a rocket to do it. In the first place, no other type of motor promises speed enough to get away from the gravitation of the earth. Even the giant cannon used in Jules Verne's story wouldn't do it.

A cannon gives all its propulsive force to the shell at the start of the flight. Now it is perfectly possible to calculate what the speed of a shell would have to be to get away from the earth, and when the calculation is made it is evident that there is no form of explosive known that will develop the necessary speed. And that isn't all; even if you could find the proper explosive, everything in the shell, men and instruments, would be reduced to a fine powder by the shock of starting.

An ordinary motor, even if developed to the nth degree of speed and power wouldn't do it either. For it takes the oxygen of the air to support the combustion of the fuel in a motor (class in chemistry, step up!) and out in space there is no oxygen. Any vehicle that ventures beyond the ten miles or so of really dense atmosphere near the surface of the earth must be prepared to carry its own oxygen as well as its own fuel.

So it had to be a rocket. About the same time two men—Professor Piccard, the stratosphere aeronaut and Professor Robert H. Goddard of Clark University, an American, struck upon the same idea. Why not have a rocket that used oxygen as part of its fuel? That is, a machine whose fuel tanks contained liquid oxygen in one tank and gasoline or liquid hydrogen in another, feeding both of them into a "combustion chamber" through tubes.

The supply of the two fuels could be controlled in some way; the rocket could then start out at a slow speed, gradually working up to the 3000 miles an hour at which it functions most perfectly. The speed, no matter how great, would not then be dangerous to the contents, humans nor instruments. It is not speed that kills but the sudden application of it, the shock due to what is called "acceleration."

Piccard began experimenting with models of rocket-airplanes; Goddard went to work on pure rockets. It was Goddard who discovered that a rocket works better in a vacuum than in air; so he built an enormous vacuum tube about a mile long and began shooting rockets through it. Piccard, whose only object was to reach the stratosphere and find out what goes on up there, then discovered that he could make it in a balloon, and dropped the rocket subject, but Goddard kept on.

After the end of the war, several European scientists, attracted by a paper Goddard had written for the Smithsonian Institution, in which he demonstrated that it was perfectly possible to send a rocket to the moon, took the matter up. All of them have made important contributions to rocket science and deserve mentioning.

Robert Esnault-Pelterie, a Frenchman, worked out to the last decimal point just what characteristics a rocket would have to have to get to the moon; Max Valier and von Opel built rocket-automobiles, rocket-gliders and rocket-motorcycles; Herman Oberth, a Roumanian, wrote books about it and carried on experiments himself. In Russia and America, Interplanetary Societies were organized, and have been carrying on regular experiments ever since.

Most of these people were interested in flying to the moon or somewhere else out in space. Therefore, they stuck to Goddard's idea of a rocket with two fuel tanks, one carrying liquid oxygen and the other gasoline or some other fuel. They all had trouble with the oxygen. It takes enormous pressure to keep oxygen liquid and when the heat of the combustion or the exhaust began to get at the oxygen tanks in these rockets, something usually let go.

Max Valier was killed in one oxygen tank explosion; Esnault-Pelterie was seriously injured in another and the rockets of both Oberth and the American Interplanetary Society came to earth prematurely when their oxygen

tanks blew out under the heat from the exhaust.

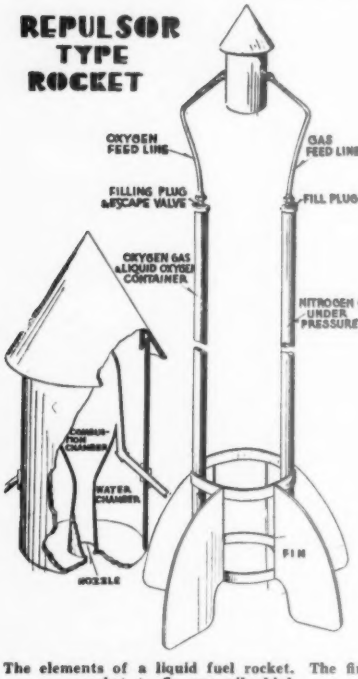
But some of the experimenters have been interested in using rockets to propel vehicles down near the earth, and it is from them that the modern experiments on rocket-airplanes and rocket-gliders have come. The point is, that if you are not specially interested in making a trip to the moon, you can use a solid-fuel rocket or a modification of the ordinary sky-rocket, with powder or something like it for power, and use the oxygen of the air for combustion.

This makes a big difference in construction. Powder cannot be fed into a combustion chamber through a tube like a liquid fuel, for once you start it burning, you can't stop it. Therefore, in machines powered with solid-fuel, you must have a number of separate tubes, each containing fuel enough for one of the "shots," which are to be fired in succession.

The machine will move forward in a series of jerks as each tube is fired, followed by a glide when no tube is firing. It isn't as smooth as a liquid-fuel rocket, but it is more efficient (solid-fuel has a higher efficiency percentage) and it is far more certain.

Skipping over the experiments with rocket railroad-cars, motorcycles and ice-boats, let's see what the rocketeers have done with airplanes.

First, there was a European rocket-glider. It was flown in 1928; powered with two von Opel powder rockets. Sthamer was the pilot; he took off from the water by means of a rubber rope, which snapped him into the air; once up he turned loose one of his rockets, did a glide, and then shot the other one. The rockets were very small and he covered rather less than a mile, but the flight was a complete success.



The elements of a liquid fuel rocket. The first rocket to fly one-mile high.

Filling the rocket motor with liquid oxygen, ready for a flight. This is the most compact form in which oxygen can be supplied for combustion and marks a great advance over the gun-powder type of rocket.

Next the big Junkers aircraft plants began taking up the rocket idea. The trouble with flying a heavily-loaded plane is getting it off the ground; once up she will fly. Junkers tried planting a row of rockets along the wings of a big transport plane, loaded so heavily she would not take off under normal conditions. The rockets were electrically connected up so that when the pilot gave her the gun they were all fired at once; the empty rocket-cases then dropped loose automatically. The experiment succeeded well enough for Junkers to decide to continue with it, but beyond that no details have yet been made public. The process is still being perfected at the Junkers plant.

About the same time the U. S. Navy began experimenting with a model rocket-powered pursuit plane. She looked very much like an ordinary pursuit biplane except that she had no motor in front and around the fuselage behind the pilot's seat were arranged a double-row of rocket tubes. She got as far as wind-tunnel tests; the model is understood to have shown excellent aerodynamic qualities and revealed wonderful possibilities, but further development is waiting on more funds. The difficulty here is finding the right kind of fuel.

In 1929 von Opel built a whole rocket plane, along somewhat similar lines and made a flight with it near Frankfort. The flight was successful, but he found his control surfaces warped under the exhaust gases and the whole apparatus required refining. Then he too, reached the conclusion of Konstantinoff, that rockets were no good for propulsion at low speeds, and dropped his experiments. It is worth mentioning that by "low speeds" anything under a velocity of 600 miles an hour is meant.

Next came Reinhold Tiling with the flight of a miniature non-man-carrying rocket. This one is thoroughly original and indicates a line of development that the rocket plane of the future may well take. It has a set of wings but, at the start of the flight, they are folded back against the rocket's fuselage to form a perfectly projectile-shaped body. When

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An Old English Radial Engine

This is the famous old Armstrong-Siddeley "Jaguar" engine having 14 cylinders in two banks.

THE photo shows the 14-cylinder Armstrong-Siddeley "Jaguar" designed in England several years ago. It bears a remarkable resemblance to the 14-cylinder twin Wasp engine in Frank Hawk's Northrup racer.

This engine has 14-cylinders arranged in two rows of 7-cylinders each, the front bank of cylinders being slightly staggered in respect to those in the rear bank to give the proper air-circulation. The Jaguar was used in the well known "Siskin" fighting planes used by the Royal Canadian air forces and in many other civilian and military ships.

At a normal speed of 2,000 r.p.m., sea-level, the output is 480 h.p. The gear ratio of 0.657 gives a normal propeller speed of 1314 r.p.m. The total weight is 890 pounds or 1.75 pound per horsepower.

Wiley Post Works in Secret

WILEY POST, who works in secret and lets his deeds speak for themselves, is grooming his round-the-world Lockheed Vega, the Winnie Mae, for new records. At the Lockheed factory, Burbank, Calif., he is having a new direct control model Westport radio receiver installed in his trim white monoplane, while mechanics are doing some mysterious work on the engine. Just what Wiley's plans are, only his closest friends know. And they won't tell.

Desert Flights Costly

BECAUSE of the high cost of rescues if flyers are forced down in the Sahara desert, France makes all foreign aviators who wish to fly over that forbidding terrain deposit 100,000 francs to be used if the flyers are captured and held for ransom by marauding Arabs.

P. A.'s New Colored Cover Drawings (On Front and Rear Covers)

THIS issue of P.A. is distinguished by having colored drawings on both the front and back covers, the latter drawings taking the place of the usual advertisement that previously appeared on the back cover.

Great care has been taken with all of these drawings in respect to the correct color scheme, insignias and other details. The drawing of the Hawker "Super-Fury" that appears on the front cover, for example, was sent to England to be checked by the manufacturer so that its accuracy is insured.

The front cover drawing of the English Hawker Super-Fury is of the greatest possible interest, for with its top speed of 250 m.p.h., the Super-Fury is the fastest military ship in the world. This ship supersedes the Hawker "Fury" to which it is very similar except for minor details, a larger engine and a shorter wing span. The exact dimensions have not yet been released, but certain factors in its performance were recently published in a Congressional report.

At sea-level, its speed is 243 m.p.h., rising to 250 m.p.h. at an elevation of 15,000 feet. Its war service ceiling is 36,000 feet and it can climb to 15,000 feet in seven minutes or a trifle faster than 2,000 feet per minute. This is truly a remarkable performance.

The Hawker Super-Fury is powered with a liquid-cooled engine which permits of a high fineness ratio for the fuselage and a resulting reduction in the parasitic resistance. Like the majority of English military ships, it is a biplane of very sturdy construction and is capable of performing various battle maneuvers at very high speed. It is said that this high speed has been attained without any sacrifice in maneuverability and that it stands in the first in its class in every essential respect.

It is significant that this high performance single-seat pursuit ship, or "interceptor," is contrary to the present trend in this country. In the first place it is a biplane, and secondly, it is provided with a liquid-cooled engine in place of the more common air-cooled engine prevalent in the U. S. Army Air Corps. The Curtiss monoplane, the XP-934, supposed to have the highest speed of any ship of this class in the United States, flies only 215 m.p.h. at sea-level, or 195 m.p.h. at 15,000 feet.

Now, turning over to the back cover, we see that Mr. Bollin has given us three fine colored drawings of well known airplanes. At the top of the column is the Northrup "Gamma," an all-metal speed ship owned by the Texas Company and flown by Frank Hawks. This is a finely streamlined job that has won many contests for Hawks and which has broken many records.

Probably the most interesting feature of the Northrup "Gamma" is the "filleting" at the point where the ends of the wing meet the fuselage. This is essentially a Northrup feature that adds to the speed by reducing air eddies near the body and which also does away with that dangerous stress on the tail-group known as "buffeting." Very fortunately, we have an excellent article on "tail buffeting" in this issue, by Lawrence Lesh, which would be very interesting to read in connection with this picture.

Then, in the center of the rear cover, is a view of the new A-12 attack plane, the successor of the A-8 attack plane of last year. The principal difference between the A-12 and the A-8 ships is in the powerplant which was liquid-cooled on the A-8 and is air-cooled on the A-12. Both planes are intended for making direct attacks against the infantry, artillery and other ground troops and are provided with machine guns and bombs. The speed of the A-8, called the "Shrike," is said to be 197 m.p.h. and it is entirely likely that the A-12 does considerably over 200 m.p.h. although no performance data has yet been released.

As attack planes will probably feature largely in the aeronautic activities of the next war, this ship should be of particular interest as being not only a new development in airplanes but also tactical importance as well. The machine guns carried by the attack plane are for "strafing" ground troops and for "mopping up" while the bombs are employed against the material of the enemy, the tanks, armored cars, armored emplacements, munition dumps and the like.

Then, last, but not least, at the bottom of the rear cover is an excellent reproduction of a wartime Nieuport "27" which is one of the very numerous Nieuport family to gain renown in the war. This particular model is not actually a biplane but is really a sesquiplane because the lower wing is much smaller than the upper surface. The "vee" shaped interplane strut, made necessary by the small chord of the lower wing, is a well known characteristic of several of the wartime Nieuports and the "27" was the last of the series. In most cases, the Nieuports were equipped with either the 80 h.p. or the 110 h.p. LeRhones engine.

For the time, when thin wing-sections were the rule, the interplane bracing is very clean and simple. There was, therefore little resistance from this source.

Because of their lightness, the Nieuports were highly maneuverable as well as possessed of a fair speed and good climb. The wings and the fuselage structures were almost unbelievably light and frail and it is quite remarkable that they stood the gaff as well as they did.

The Electra Is the Fastest Multi-Motor Airliner

Showing the clean lines of the new Lockheed "Electra," a bi-motor all-metal transport ship.

FLASHING across the sky at an air speed of 221 miles per hour, the new bi-motor Lockheed Electra established a new unofficial world speed record for multi-motor transport planes over the measured California Institute of Technology 4-kilometer course near Santa Ana, Calif.

Top speed of the Electra at 5000 feet, as shown by the accurately calibrated air-speed meter, was 221 miles per hour. At 75 percent. of power, cruising speed was shown to be 203 m.p.h. at 10,500 feet. The power plants are two supercharged P. & W. Wasp Junior engines, rated at 420 horsepower each at 5000 feet. They are equipped with Hamilton Standard controllable pitch propellers.

With an observer holding a stopwatch, Eddie Allen, test pilot, flew the Electra back and forth over the course 16 times close to the ground where accurate observation was possible. In this manner, the air-speed meter was checked against average ground speed. The actual speed trials were flown at higher altitudes.

And Now Enters the Avigator

by LIEUT. COMM. P. V. H. WEEMS (Retired)

WITHIN our own generation, "avigation" or aerial navigation, has grown up from nothing to the dignity of a profession.

It is not even necessary for a person to be a pilot in order to qualify as an air navigator. Harold Gatty, among the first to win fame as an avigator, is not a pilot and has no ambition to become one. On the other hand, a competent avigator who is also a qualified pilot possesses the ideal qualifications.

An example of the flyer-avigator is Anne Lindbergh. Not only is she a skilled avigator, but she is also a qualified flyer. In addition, she is an expert radio operator, a qualification which is rapidly becoming indispensable with the finished avigator.

That women are well suited to become capable avigators has been conclusively demonstrated by Mrs. Lindbergh on the 1933 survey flight with her husband.

Not only did she operate the radio, both transmitting and receiving in code, but she also took all ground-speed and drift observations with the new Gatty instrument, kept the log of the flight, and took the controls as relief pilot while her husband made sextant observations of celestial bodies and reduced these observations to positions.

This arrangement gave increased factors of safety in operating the plane, not to mention the personal comfort of having a rest after hours of handling the controls.

It is unfortunate that the qualifications necessary to make a good avigator differ greatly from the qualifications which are required in the skilled pilot. The difference is largely psychological. The pilot at the controls must be continuously on the alert. With the engine humming steadily and the flying conditions good, very little physical or mental effort is required yet the nature of flying requires the pilot to be on the *qui vive* at all times.

In bumpy air, the pilot must react quickly when a wing dips, or the plane is thrown into a dive or steep climb. In landing, a fraction of a second delay in the proper handling of the controls might result in damage to the plane or even to the occupants.

On the other hand, the work of the avigator is entirely different in character. Where the pilot's mind should ordinarily be lightly occupied but con-

(*Concluded on page* 395)

The Kid Glove Pilot

by ALVIN V. HELLER

THIS is the story of the "Kid-Glove" Pilot. Ever see him? Correctly dressed, always, whether pushing an OX-5 Swallow or a big "Tin-Cow."

I even think he had a monocle tucked away in his waistcoat. Spats, derby hat, form fitting overcoat and white muffler. Catch him wearing a brown suit, white shirt and green tie? Never! I'll bet that guy bought more kid gloves in a year than any other man living! Not that he was a sissy—far from it—for all his six feet, one inch, he was well proportioned.

He could handle himself pretty well too, as the crowd at the field found out when a "kiwi" tried some smart Alec stuff, with one of his customers. We never exactly knew where he came from and it would be a pretty tough guess if you tried to judge it from his vocabulary. Sometimes he drawled his r's, then again he spoke New Yorkish and oftentimes he dropped his h's like a real Cockney.

We heard of him first when he was working a small town about sixty miles away from the field. He had a flying school, carried passengers and carried on the general routine of flying.

I remember he came over to our field late one Spring in 1928, when the field was all mud, to pick up a tombstone—of all things. Although everyone was wearing boots, damned if that guy wasn't wearing spats—and never even got his shoes muddy! Well, it seemed that the "tombstone" was some kind of a publicity gag he had worked up. I remember "Tex" couldn't pass up the chance and cracked wise. But this guy just gave him a friendly smile and let it go at that.

We didn't see much of him after that, except when he was ferrying some ship and then he would stop off for gas. They were mostly new ships from the factory at Troy. He was still most fastidious.

Later on he got the distributor's job for our half of the State and he located at our field. Had a nice smile that made him liked at the field and he certainly was conscientious about his job because Pete signed his log for plenty of "time" during one month. Jim Welch reported turning on the lights for him a couple of nights a week when he was pushing his job till late at night. Even Jim noticed his clothes—freshly pressed—and always the new kid gloves.

I figured something was hay-wire when I found old "Pop" Lewis and "Tex" arm-in-arming it over to feed one day.

When those two old buzzards got chummy, something was always afoot. Well, anyway, it wasn't long before we were all in on it. Seems it had been "rankling" old Tex that this bird always looked like he'd stepped from a bandbox. So Pop and Tex figured a

(*Concluded on page* 402)

Practical Lessons in Aviation

by JOHN B. RATHBUN

The air flow about an airfoil in producing lift is an interesting study. In this installment, we find how the air-stream is deflected and how the resulting pressures are distributed over the surface of the wing-sections.

HAVING by this time, a good idea of airfoil or wing-section development, together with a general acquaintance with the characteristics desired in flight with these airfoils, our next investigation will lead us to a study of the airflow around the wing-sections and the forces produced by the action of the air.

The whole matter is quite complicated, because with a flowing fluid, such as air, there are almost countless interactions and reactions taking place within the body of the unconfined fluid. Any knowledge, therefore, that we can have of this swirling mass of air is only an approximate or "empirical" knowledge based upon rather crude measurements of the forces thus produced. That this is true is evident from the fact that lift calculations cannot be made directly on unknown airfoil, but only from data obtained by actual tests on a particular airfoil that has been made in a wind-tunnel or equivalent.

There have been many theories and methods of calculation proposed by which the lift, drag and center of pressure movement could be computed directly from a wing section, but in nearly every case such methods have proved highly inaccurate. Even wind-tunnel tests are not all that they should be from a standpoint of accuracy, hence the only real and true method of finding out what a full size wing section will do is to try out the full size wing under actual flying conditions.

So many variables enter into the wing problem that adequate compensation is difficult to make. Varying density, turbulence, kinematic viscosity relations, etc., etc., all take their toll of accuracy in wind-tunnel model tests, and the fact that the findings made by one laboratory on a given model do not agree with those of another laboratory, with great exactness, should be ample evidence that the science of aerodynamics is not yet an exact science.

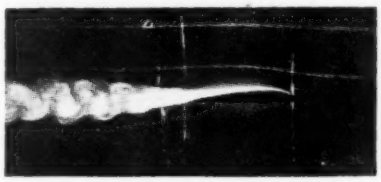
As we know, from a previous lesson, the lifting force on an inclined flat plate is due to two distinct conditions of flow. First, we have the high pressure on the lower surface of the inclined flat plate, often known as the "dynamic pressure," that is directly due to the impact of the air particles on this lower surface. Second, is the "induced lift" due to the reduced pressure (partial vacuum) over the upper surface of the plate. Acting together, the dynamic pressure below and the induced pressure above the wing (partial vacuum) can be combined to produce the total upward pressure on the plate called the lift.

Much the same reaction takes place with an airfoil or wing-section, but due to the approximate streamline form of the practical airfoil, the total lifting effect is greater with a given air velocity and the drag is relatively much lower in respect to the lifting force. There is less disturbance of the air with the true airfoil than with the flat plate and therefore less loss of energy.

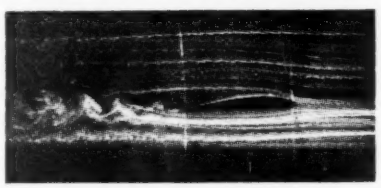
Within certain limits, the lift obtained with an airfoil increases with the angle made by the airfoil with the air-stream. As indicated in Fig. 1, the angle is indicated by (a), the angle made by the chord or datum line of the wing with the undisturbed air-stream, giving a lift (L). This is known as the *"angle of attack"* (a) which must be carefully distinguished from the *"angle of incidence"* which is quite another matter. The angle of attack, as commonly defined, is the angle made by the chord or datum line with the air-stream unless otherwise stated.

In Fig. 2, we have the angle of attack reduced to "zero," but there is still some lift (L_m) taking place even with ($a = 0$) because the wing-section is not symmetrical with the air-stream. Because of the top camber, air is still being deflected downward, hence lift must still exist. However, if the airfoil were symmetrical, that is with equal camber on top and bottom, there would be no lift at the zero angle of attack because the air would be equally de-

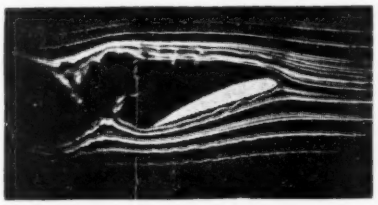
***BELOW** are four photographs taken by the National Advisory Committee on Aeronautics in a smoke tunnel, the filaments of smoke indicating the air flow around the airfoils under various conditions. The turbulence is very sharply marked.*



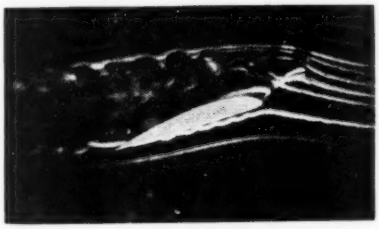
Air flow over an airfoil placed at a small angle of attack. Stream adheres to back of airfoil.



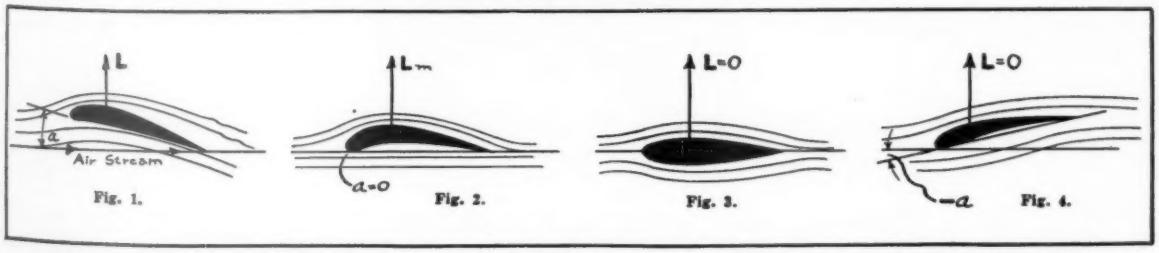
The angle of attack is somewhat increased and the stream is starting to break away.



The "burble-point" is reached, an angle at which the stream breaks away abruptly.



Another form of flow taking place at the burble-point with nothing but turbulent eddies.



Diagrams showing the relation between the airfoil angle (a), called the "angle of attack," and the upward vertical lifting force (L).

flected and accelerated on both sides. This is indicated by Fig. 3.

It is evident, therefore, with the usual type of unsymmetrical airfoil (Figs. 1-2), that the angle of attack must be "negative" or less than zero to completely lose the lifting effect. This negative angle, causing zero lift, is indicated by (—a) in Fig. 4, and is therefore known as "the angle of zero lift," or, L = 0.

In some few cases, the angle of attack made by a wing under given conditions is measured from the angle of zero lift instead of measured as in Fig. 1. This has certain advantages but it is usual to state that the angle of attack is measured from the angle of zero lift when such measurements are made. In the drafting room and shop, however, it is easier to use the chord angle as in Fig. 1 as this gives us a definite point to measure from and does not require wind-tunnel data.

In starting to describe the action of the air-stream in developing lift, allow me to say first that there are a multitude of theories on this subject. The fact that there is a pressure below the wing that forces it up, aided by the reduced pressure above the wing, does not fully explain what takes place. But, just to avoid argument, we will make a brief study of the Prandtl Theory which is popular just now, a theory which is also frequently attributed to Kutta and Joukowski.

In Fig. 5 we have a non-turbulent flow of a non-viscuous fluid about the airfoil, the stream parting and flowing both along the top and bottom surfaces. The pressures on the upper surface being lower than atmospheric pressure are indicated by (–p). The pressures on the lower surface being higher than atmospheric are therefore shown by (+p). The total pressure must then be the sum of the two since they both act in the same direction. The wing is at zero or a small angle of attack.

Now, Bernoulli's Theorem states that in a freely flowing fluid, the velocity is highest where the pressure is lowest, and again, the velocity is lowest where the pressure is the greatest. Therefore, in Fig. 5, the air velocity must be greatest over the top of the wing where the pressure is the least and the air velocity is slowest beneath the airfoil

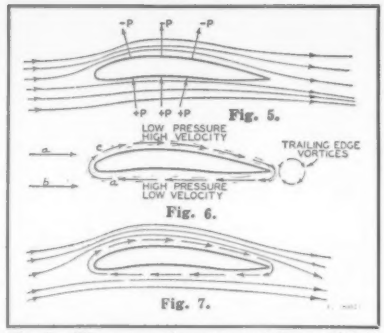


Fig. 5.

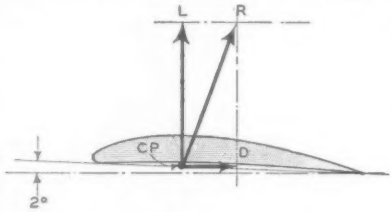
Fig. 6.

Fig. 7.

Fig. 8. Elementary forces created by an airfoil. The reaction (R) is the sum of all forces which can be resolved into the vertical lift (L) and the drag (D). The center of pressure is at (CP).

where the pressure is greatest. This is one reason why the lift on the top surface is greater than on the bottom—though not the whole reason. This velocity difference in turn sets up a still greater difference in the top and bottom velocities, because the pressure on the underside opposes the flow of air since it is counter to the air-stream.

This is made clearer by Fig. 6 where it will be seen that the difference in the top and bottom pressures establishes an independent circulatory flow,



the air flowing from top to bottom as at (d) and (c) all around the airfoil. It is obvious that the cyclic flow at (d) opposes the air-stream at (b), but at (c) the air-stream flow is accelerated since (c) is flowing in the same direction as the streamlines (a). Therefore the difference in the velocities above and below the airfoil is very considerably augmented by the cyclic flow.

According to Prandtl, the circulation is maintained by the whirling vortices at the trailing edge which rotate in a contrary direction to the main circulation. Tests show that these vortices are rapidly formed and broken off at this point. Fig. 7 shows the uniform flow diagram of Fig. 5 superimposed upon the cyclic diagram of Fig. 6 which is the actual flight condition.

The confluence of the upper and lower streams at the rear together with the vortices, produce what is called "induced drag" by Prandtl. This induced drag, due to the cyclic system is also a horizontal component of the lift and varies with the lift. More directly, the induced drag is a function of the "down-wash" of the wing or the downward deflection of the air-stream, and this down-wash is directly related to the loading of the wing. The equation for the induced drag is:

$$\text{Induced Drag} = \frac{L^2 \times A}{3.14 \times S^2}$$

Where: L = total lift in pounds: A = area in square feet and S = the wing span in feet. The induced drag, therefore, increases with the square of the lift, with the area and inversely with the square of the span.

The second factor contributing to the total drag is the "profile drag" caused simply by the frictional resistance of the air over the airfoil surfaces. This is primarily due to the viscosity of the air or to the property of air that makes it adhere to the surfaces. It is independent of the induced drag. A thin film sticks to the airfoil, and the force required for shearing this layer over the next outer layer of air is the profile drag. Summing up, we have:

LAWS OF DRAG

1. Profile drag is primarily due to shearing through viscuous air.
2. Profile drag is largely dependent upon the area of the surfaces and the type of airfoil.
3. Profile drag does not vary much with the angle of attack within the ordinary range of angles used in flight.
4. The induced drag is zero when the lift is zero.
5. Induced drag, therefore, increases with the angle of attack.
6. Induced drag increases with the lift coefficient of the airfoil.
7. Induced drag decreases with an increasing aspect ratio, or in other words, is reduced by narrow slender wings.
8. TOTAL DRAG is equal to the sum of the induced and profile drags.

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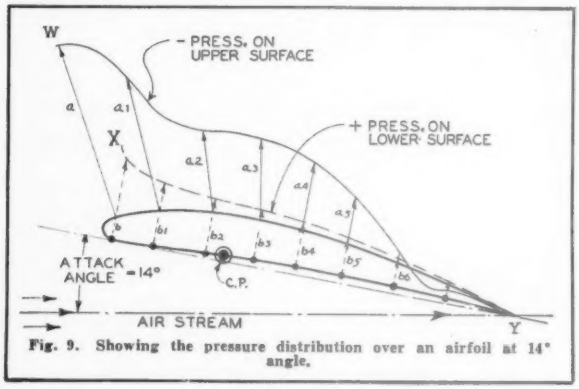


Fig. 9. Showing the pressure distribution over an airfoil at 14° angle.

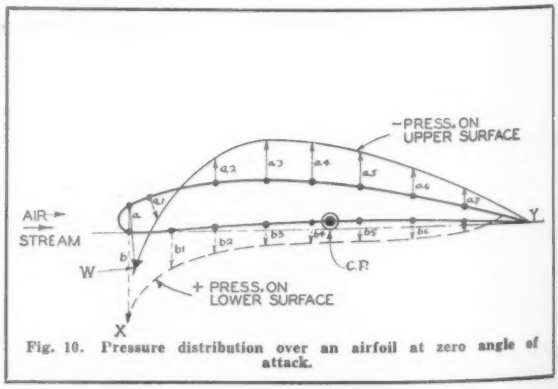


Fig. 10. Pressure distribution over an airfoil at zero angle of attack.

Simple Landing-Light

DONALD D. COOKE, Teaneck, New Jersey, has designed a simple landing-light and has installed it in his Lambert-powered Monocoupe.

An ordinary spotlight, the same as those in use on automobiles for finding house numbers, avoiding ditches, etc., was mounted under the Monocoupe's fuselage, directly beneath the pilot's seat. Held in place by a bracket and a piano hinge, the light can be cranked up flush with the bottom of the fuselage so that it offers no resistance to the air.

When the light is to be used, the pilot cranks a small handle, (a Ford window crank) and the light shines downward at the required angle. The bulb used is 21 candlepower and is run by the plane's storage battery. Ships having no storage battery could make use of a hot-shot or dry cell.

The crank lies flat on the floor of the cabin and does not interfere with any of the controls. A system of levers actuates the retracting feature.

Mr. Cooke, who is a member of the Sportsman Pilot's Association, uses his ship for pleasure for the most part, but if business calls, he gets out the Monocoupe and goes places. On several occasions last Fall he returned from football games late in the afternoon and had to land at an unlighted airport in the dark. Seeing the need for a practical, inexpensive light, he set to work on this idea.

I'M AFRAID WE CAN'T PASS HIM, DOC — HE COULDN'T WIGGLE HIS EARS!
APPLICANT FOR TRANSPORT LICENSE
100 LBS.
CARPET TACKS
ARTHUR POINIER

It's getting harder and harder for the poor transport pilot.

AVIATION ENGINES—EN-TL-80

LIGHTPLANE ENGINES IN AMERICA

Name	Model	Rated @	H.P. R.P.M.	Cylinders No.	Bore	Stroke	Disp.	Wt. Dry Strip	Lbs. H.P.	Comp. Ratio
*Aeromarine	AR3	50	2125	3R	4.13	4.00	160	150	3.00	5.0
*Aeromarine	AR-340	40	2050	3R	4.13	4.00	160	150	3.50	5.0
Aeronca	E-113	36	2400	2J	4.25	4.00	113	105	2.85	5.1
Aeronca	E-107A	30	2500	2J	4.13	4.00	107	100	3.33	3.8
*Aeronca	E-113A	36	2400	2J	4.25	4.00	113	110	3.05	5.1
Church	Mar'thon	.....	.....	4L	.....	.....	.....	.....	.....	.....
Continental	A-40	37	2550	2J	3.13	3.75	115	136	3.70	5.2
*Continental	A-40-2	37	2550	2J	3.13	3.75	115	144	3.85	5.2
Crosley	113	40	2400	2J	4.25	4.00	113	118	2.95	5.75
Dragon	?????	62	2000	4L	4.00	4.25	214	170	2.74	5.40
*Ford (Convert)	"A"	....	.....	....	.....	.....	....	.....	.....	....
*Heath	B-4	25	2800	4L	2.75	3.50	83	119	4.76	4.5
*Henderson	.....	25	3000	4L	2.75	3.50	83	Var.	Var.	4.25
Irwin	Meteor	22	1850	4R	2.88	2.75	79	55	2.50	4.8
Jacobs	L-3	55	2125	3R	4.13	4.75	190	170	3.09	4.8
*Lambert	R-266	85	2250	5R	4.25	3.75	266	214	2.40	5.6
LeBlond	5-DE	70	1950	5R	4.13	3.75	250	235	3.35	5.4
*Long	Harleq	....	.....	2J	.....	.....	.....	.....	.....	....
*Menasco	Pirate	95	2000	4LI	4.50	5.13	326	280	2.95	5.5
*Rover	?????	75	1975	4LI	4.13	5.00	267	228	3.25	5.1
Salmson	AD-9	42	1700	9R	2.75	3.38	182	160	3.81	5.6
Szekely	SR-3-O	45	1750	3R	4.13	4.75	191	135	3.00	5.0
Szekely	SR-3-L	30	1750	3R	4.13	4.75	191	135	4.43	4.8
Szekely	SR-5-L	65	1750	5R	4.13	4.75	317	185	2.84	5.0
Tiger Junior	"50"	50	1600	4	3.75	3.50	154	130	2.60	5.3
Tiger Kitten	"20"	20	2300	2	3.75	3.50	77	60	3.85	5.3
Tiger Kitten	"30"	30	1500	2	3.75	3.50	77	75	2.50	5.3
Velie	M-5	65	2000	5R	4.13	3.75	250	223	2.92	5.4
Warner Scarab Jr.	.....	90	2025	5R	4.25	4.25	301	230	2.56	5.2

Under cylinder arrangement column, "J" indicates an opposed type, "L" are vertical "in-lines", "LI" are inverted in-lines and "R" are radials.

Several of the above engines are no longer manufactured but are listed here as they can frequently be picked up from various sources. Engines marked (*) are being made at the date of this writing, while the others are either "orphans" or present conditions are unknown by us.

While a lightplane is usually defined as one having an engine of 50 h.p. or less, engines up to 100 h.p. are listed as they are sometimes used on light racing planes or planes that are "light" in every other particular.

AVIATION ENGINES—EN-TL-81

ENGLISH LIGHTPLANE ENGINES

Name	Model	Cylinders No.	H.P.	R.P.M.	Engine Type	Bore—Stroke m.m.	Disp. CU. M.M.	Wt. Em'ty Lbs.
A. B. C.	Scorpion II	2	38	2250	(J)	.....	.....	.....
A. B. C.	Hornet	4	82	2175	(J)	102x122	3990	245
Anzani (British)	.....	2	38	3000	I-V	83x101	1098	140
Armstrong-Sidd	Genet	5	82	2200	R	102x102	4120	219
Armstrong-Sidd	Genet Major	5	110	2420	R	108x114	5230	261
Armstrong-Sidd	Genet Major	7	140	2420	R	108x114	7320	.....
Cirrus-Hermes	Cirrus III	4	95	2100	L	110x130	4939	285
Cirrus-Hermes	Hermes	4	115	2100	LI	114x140	5717	310
Cirrus-Hermes	Hermes II	4	120	2200	I	114x140	5717	318
Cirrus-Hermes	Hermes IV	4	130	2200	LI	120x140	6330	300
Coventry Victor	O. H. V. IV	2	30	3500	(J)	78x 78	749	70
DeHavilland	Gipsy I	4	90	1900	L	114x128	5226	285
DeHavilland	Gipsy II	4	120	2200	L	114x140	5716	298
DeHavilland	Gipsy III	4	120	2200	L	114x140	5716	290
DeHavilland	Gipsy Major	4	130	2350	LI	118x140	6124	302
Douglas	"Dot"	2	18	3000	(J)	68x 82	596	80
Douglas	"Digit"	2	22	3000	(J)	76x 82	746	85
Douglas	"Dryad"	2	36	3300	(J)	92x 92	1200	110
Napier	E. 97	6	150	2000	LI	4.5 x 5.3	.....	.....
Pobjoy	"R"	7	85	3300	(R)	77x 87	2835	135
Pobjoy	Niagara	7	90	3200	(R)	3.03x3.42	.....	145
Pobjoy	Cataract	7	75	2900	(R)	3.03x3.42	.....	135
Pobjoy	Cascade	7	65	2600	(R)	3.03x3.42	.....	126
Salmson	A. D. 9	9	54	2310	(R)	70x 86	2979	160
Salmson	A. C. 7	7	120	2200	(R)	100x130	7150	286
Salmson	A. C. 9	9	150	2200	(R)	100x130	9189	347

Under "Engine Type" column, (J) indicates an opposed type, (L) is a vertical in-line and (LI) is an inverted in-line.

NOTE: English lightplane engines reach a maximum of 150 h.p., which is a considerably higher rating than lightplane engines in the United States. In fact, the English lightplane engines embrace our "sport-type" planes as well as the conventional lightplane field.

It is common British practice to quote the bore and stroke in millimeters while the displacement is, of course, in cubic millimeters with but few exceptions. The empty weight is the same as our "Dry-weight," but includes the machine weight complete with carbureter, magneto and propeller hub.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-14

Air-Gas Mixtures. Combustible mixtures of air and gasoline vapor.

Air-Gas Ratio. The ratio of the amount of air to the quantity of gasoline vapor either by volume or by weight. The ratio for gasoline vapor varies over a considerable range for combustion.

Air-Helix. Screw type propeller for airplane. See PROPELLER.

Air Hole. Areas with downward currents of air which cause a plane to drop suddenly, apparently as if it ran into a vacuous space.

Air (Humid). Air containing water vapor or moisture.

Air Humidity. Amount of water vapor contained in air, measured in grains of water per 100 cubic feet of air.

Air Humidity (Relative). The ratio of the amount of moisture contained in the air to the quantity of moisture required for saturating the air at that temperature.

Air Intake. The opening through which air is drawn into carburetor or cylinder.

Air Inversion. A local condition under which the temperature no longer decreases with an increasing elevation. This may take place occasionally in certain localities, and under some conditions, the temperature may even increase with the altitude for a short distance.

Air Kicker. Compressed-air starting motor for an aviation engine.

Airlane. A route traversed by a scheduled commercial airline.

Airline. An individual, company or corporation operating aircraft for the conveyance of passengers, freight, mail or express matter. A commercial aircraft operator.

Airliner. Craft operating on an **AIRLINE.**

Air-lock. An accumulation of air at a high point in a pipe or fluid circulating system that blocks the flow of the fluid.

Airlog. A record of flight giving the hours of flying and incidents occurring during the flights. A flight diary.

Airlogged. An airship or balloon with the gas so diluted with air that it can no longer sustain itself in the air.

POPULAR AVIATION, 1934 DIC-A-14

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-13

Air-lube. An oil or grease for reducing air friction on a surface.

Airmap. (1) A map made from an aerial survey, generally by photographic means. (2) A map containing information of interest to the pilot of an aircraft.

Air Mapping Plane. An airplane specially designed for photographically surveying.

Air-miles. (1) Distance traveled through the air without respect to the earth. (2) The distance traveled by aircraft between two points, or a course traveled by aircraft.

Airnaut. The pilot of an airship or a balloon.

Airplane. A heavier-than-air craft supported by the reaction of an air-stream flowing over fixed wings while the machine is being propelled forward. Lift is dependent upon the forward motion of the craft.

Airplane Axes. An airplane in flight can rotate about three principal axes: the longitudinal "X" axis through the body, the lateral "Y" axis passing through the wings and the vertical "Z" axis.

Airplane Base. Headquarters or main airdome from which military airplanes are directed.

Airplane Bomber. A military airplane arranged for carrying and dropping aerial bombs.

Airplane Controls. The adjustable surfaces and actuating mechanism by which the attitude, equilibrium and flight plath of an airplane are controlled.

Airplane Gasoline. A special gasoline (AVIATION GASOLINE) designed for withstanding the high compression and special operating conditions of an airplane engine. It must permit easy starting at low temperatures and have a high octane rating, usually above 75.

Airplane Performance. The operating characteristics of an airplane such as the top speed, cruising speed, landing speed, rate of climb, ceiling, maneuverability, stability, etc.

Airplane Pilot. The operator of an airplane. In the United States, the pilots are graded in the following manner: Student pilot, Amateur pilot, private pilot, semi-commercial pilot, industrial pilot, Transport pilot and Airline pilot, according to the amount of flying time.

POPULAR AVIATION, 1934 DIC-A-13

Mr. Loose Disagrees With Us

OUT in Bettendorf, Iowa lives Mr. Chester Loose, a reader who revels in the carnage of the air-races. So firmly is he attached to his favorite outdoor sport that he wrote us a letter full of fire and brimstone denouncing us and all beliefs. He is all hot and bothered over a recent article appearing in P.A., and contrary to his belief, we delight in reprinting his valentine word for word. So here he goes:

Dear Editor;

It's to bad that a Magazine like Popular Aviation has to publish articles like (Death Stalks the Air Racers), especially considering the source that it came frome, The only reason that the **(*)** that rote the article is not racing today is that nobodv is fool enough to let him fly their plane,

You profess to try to promote the development of aviation and you should as that is what keeps vour magazine going, but the onlv type you promote is the barnyard type, mabey that is the class that purchas your publication.

Do you ever read the papers, well recently the front pages have been covered with (Airmail Pilot Crashes), I suppose that Uncle Sam. better stop carying the mail that way it's to dangerous somewone might get hurt, Well in case you guys dont know it takes humann lives to develop any thing that is to advance, and if you or your friend William, are to big a **(*)** to take a chance in the development of aviation you better dig in somewear.

The only trouble is in this country we individuals have to spend our own resources for the development of speed and in several other countries have appropriations for that purpose,

Some time ago you published an article and stated that there was no good come car frome or airoplane racing. Alright read the ad's on the new cars some read like this, (Frome the race track come the Stama and frome the airoplane comes the shape).

Do you ever notice how many are killed in playing football every year, Well there not going to stop playing football, If you'r afraid to get hurt stay out.

Who developed the retractible landingear, the wheel pants, the ring cowling, the were all developed for racing and now used for commercial planes.

As long as machines are made men will be killed and as long as Airoplanes are made there will be races;

Well keep on promoting Ford engines for Airoplanes and the younger generation will never get old enough to build racing planes.

I am not truly yours:

If you publish this I will take a year subscription to your old sheet;

Spaces marked (*) are for the naughtv words that we have deleted to avoid trouble with the postoffice.

We have only three comments to make. No. 1. Chester is all wrong about the development of cowling. Cowl rings were first introduced on passenger carrying planes and were developed in the laboratory—not on racers. No. 2. Landing gear pants were known as "harem skirts" way back in giddy 1910, 1911 and 1912 and were used on all-purpose planes. No. 3. Retractable gears were nothing new in 1919. Ask Capt. James V. Martin or Dr. Christmas who first applied this idea—and not on racing planes either.

And again, we're quite proud to be the promoters of what you call "barnyard" aviation, for it is from the barnyard and cowpasture experimenters that most of the new ideas come. And we're proud that amateur pilots and plane builders do constitute a considerable percentage of our readers.

And, contrary to another opinion, Uncle Sam did stop the army pilots from carrying the mail any longer, for the very reason that Mr. Loose advances. It was too dangerous and too many of these boys were getting killed.

Well, the last lines of his letter carried a challenge and this is a challenge that we'll accept. All right, Chester, dig up that $2.50 for a year's subscription and we'll send you twelve copies of P.A. spaced at intervals of one month apart. And if you don't make good on this bet we'll let the rest of the readers know about it—pronto.

An Aviation Engine Quiz

Compiled by P. A. Technical Staff.

The second article in the series on aviation engines. We are yet in the elementary phases of the subject, discussing the principles upon which the aviation engine is based and upon the reactions taking place in the cylinders.

Q. What limits the compression pressure?

A. *When the compression is carried above a certain point, the heat of compression becomes so great that the mixture "detonates" or explodes spontaneously causing severe knocking and loss of power. This is called "self-ignition" and must be avoided unless the engine is specially designed for this purpose.*

Q. Is there any way to increase the compression pressure and thus attain higher efficiency without danger of detonation?

A. *Yes. By the addition of tetra-ethyl lead, benzol or toluol to the gasoline. A small percentage of alcohol has the same effect. Ethyl gasoline contains tetra-ethyl lead.*

Q. Do some gasolines or liquid fuels detonate more violently than others?

A. *Kerosene detonates at very low compression pressure, and low grade gasolines, which are not much better than kerosene, also detonate at low pressures. The high-grade aviation gasolines can withstand high compressions without detonation but are correspondingly more expensive.*

Q. Then, the compression and efficiency are controlled largely by the detonative qualities of the gasoline in the gasoline engine?

A. *Yes, this is true.*

Q. Are there any fuels that do not detonate?

A. *Yes, toluol benzol and alcohol.*

Q. Does the gasoline explode instantly when ignited?

A. *No, not when the engine is operating properly. There is no real explosion, only a very rapid combustion that takes a measurable length of time for its completion.*

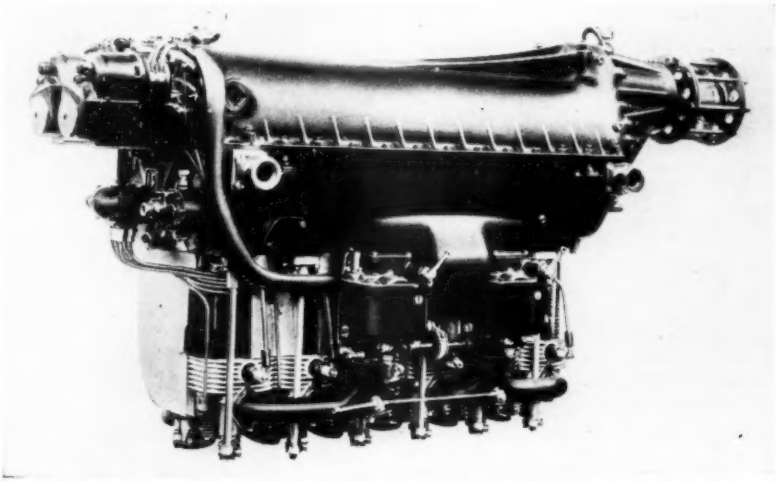
Q. How long does the combustion exist?

A. *Sometimes during the full length of the stroke as you may discover by noting flames coming out of the exhaust. Theoretically, combustion is supposed to be completed at the beginning of the working stroke but owing to poor mixtures this is seldom accomplished. The fact that combustion should be completed before the piston moves, gives this type of engine the name of "constant volume engine."*

Q. Are there any other methods of increasing the power output and efficiency of an engine except by increasing the compression pressure?

A. *Yes. First by making the mixture whirl faster or making it "turbulent" just before ignition so that the flame will spread faster. Second, by using two or more spark-plugs so that the flame will have a shorter distance to travel. Third, by pumping the mixture into the cylinder by a supercharger so that a greater weight of gasoline is taken into the cylinder.*

Q. How are the incoming mixture and the outgoing exhaust gases controlled?



An example of an "Inverted In-Line" aviation engine of the six-cylinder, air-cooled type. This Italian engine, built by Isotta-Fraschini, is known as the "Asso 80-RR." The cylinders hang normally below the crankcase as shown.

A. *By means of two valves at the end of the cylinder. One, the inlet valve, controls the mixture. The second, the exhaust valve, controls the exhaust gases. The inlet valve is open during the suction stroke and is closed during the remaining strokes. The exhaust valve opens near the end of the working stroke and remains open until the piston nears the end of the scavenging stroke.*

Q. Why is the mixture compressed before it is ignited?

A. *Compressing the mixture increases both the efficiency and the power output of the engine. Within limits, the higher the compression, the greater will be the power delivered and the lower will be the heat losses.*

Q. About how high is the compression pressure?

A. *It varies all the way from about 60 pounds per square inch in the old automobile engines to about 140 pounds The average for aviation engines is about 100 pounds per square inch.*

Q. How does the amount of gasoline affect the power output?

A. *Among other things, the power depends upon the weight of the gasoline burned per working stroke. In turn, the weight of gasoline burned is limited by the amount of air that can be taken into the cylinder to oxidize it.*

Q. Is all of the air effective in burning the gasoline?

A. *No. Only the oxygen of the air enters into combustion and this amounts to about 21 percent. of the total volume of the air. The remainder is nitrogen gas which is inert and takes no place in the combustion.*

Q. If the nitrogen could be removed would the output be greater?

A. *Very much greater, probably four or five times as much power could be had from a given cylinder with pure oxygen in place of air.*

Q. Does the presence of nitrogen cause any other losses in the cylinder?

A. *Yes. The nitrogen not only dilutes the mixture, but it retards the combustion by the absorption of heat and by interfering with the contact between the gasoline vapor and the oxygen. And, again, the heated nitrogen carries heat with it through the exhaust.*

Q. Can oxygen be produced chemically in the cylinders?

A. *Yes, but it is not practical. The addition of sodium peroxide, manganic acid, picric acid or chromic acid will decompose with the heat and supply additional oxygen and give additional power.*

Q. Are there any other factors restricting the weight of air into the cylinder?

A. *Yes. At high altitudes less air enters the cylinders because the air pressure is lower and the density is also reduced. Again, air friction in the carbureter, small valve openings and friction in the manifolds all tend to reduce the weight of air taken in per stroke.*

Q. Is the cylinder ever completely filled with air?

A. *No. The ratio of the volume of air actually taken in to the volume of the cylinder is from 70 to 80 percent. at sea-level and very much less at high altitudes.*

Q. Is there a name for this relation?

A. *Yes. It is called "Volumetric Efficiency," the ratio of the actual air to the cylinder volume at sea-level pressure.*

Q. Has this any relation to the compression-ratio?

A. *Indirectly. The compression ratio is the relation of the entire cylin-*

der volume, including the clearance space, to the volume swept out by the piston. This relation determines the compression pressure to a great extent.

Q. What is meant by the term, "Displacement?"

A. The displacement of a cylinder per stroke is the volume in cubic inches displaced by the piston during one stroke. If (D) is the piston diameter and (L) is the stroke in inches, then the displacement of one cylinder becomes:

Displacement = 0.7854 x D x D x L = cubic inches.

Q. Has the displacement anything to do with the power developed?

A. Among other things, the piston displacement is a measure of the power produced and affords a means of comparing engines.

Q. Is there any simple rule for calculating the horsepower of a gasoline aviation engine?

A. No. There are so many unknown variables and differences between different engines that an accurate simple rule or formula is out of the question.

Q. Give a rule for an approximate estimate of engine horsepower.

A. An examination of a number of American aviation engines show that there is an average of from 3.2 to 3.5 cubic inches of displacement per horsepower. Taking 3.4 cubic inches will be a safe value. Then:

$$Horsepower = \frac{Total\ Displacement}{3.4},\ or$$

completely,

$$Horsepower = \frac{0.7854 \times D \times D \times L \times N}{3.4}$$

In the above formula, (D) is the cylinder bore, (L) is the length of the stroke (all in inches) while (N) is the total number of cylinders.

Q. What is a horsepower?

A. The horsepower is the standard rate of doing work. It is equal to 33,000 foot-pounds per minute, or is equal to the force overcome multiplied by the velocity in feet per second. Thus, if the engine is hoisting a load of 165 pounds at a speed of 200 feet per minute, this is equal to: 165 x 200 = 33,000 foot-pounds or one horsepower.

Q. What represents the force and the velocity in driving an airplane?

A. The force to be overcome by the engine is the total drag or resistance. The velocity is the speed of the airplane in feet per minute. When miles per minute are used, divide the foot-pounds per minute by 375.

Q. How is the actual horsepower of an engine determined?

A. By means of a "dynamometer" which applies a known load to the engine. The apparatus may also be called a "brake," hence the actual horsepower on test is known as its "brake-horsepower."

Q. What is meant by nominal horsepower?

A. The nominal or "named" horsepower is the socalled rated horsepower which is simply an approximate figure for the engine. It is usually the nearest even figure to maximum the actual horsepower.

Q. What is meant by B.H.P.?

A. This is the abbreviation for brake-horsepower or the actual power

(*Concluded on page* 402)

The Aero-Sportswomen

by JOAN THOMAS

BUILDING seadromes for meteorological research and weather reporting stations was advocated by Amelia Earhart in an address she gave before the Geographic Society of Chicago recently.

"Seadromes are a type of aviation experimentation impossible for private interests but that the government could well carry on," she said. "If only one is built for weather reporting alone, it would be worth the cost. The possibility of developing a chain of them as landing places for a trans-oceanic air service could be developed later. But I believe that a couple, or even *one* now, would be of great value in studying mid-ocean weather conditions."

At the beginning of her lecture, Miss Earhart asked her audience three questions. First, how many of those present had been in an airplane within the last two years. Second, how many would be willing to take a trip on one of the regular established airlines, and last, how many would *refuse* to go if they had the opportunity. There were a surprisingly small number of hands raised in answer to the first question, a quick flutter of many for the second, and a rather hesitant, but determined (yea, defiant) few came up for the third.

It was toward this last group that Miss Earhart directed her discussion, attempting to show by statistics and to persuade them by simple reasoning, that they would learn to accept air travel as casually in the future, as they do the telephone and automobile today.

Even after two years of almost constant lecturing, the curiosity of the public seems unabated—Miss Earhart knows it is the story of the Atlantic flight that fills the lecture halls—but being keenly interested in the development of the industry, she has been quick to realize the opportunity it offered. She does not stop with a mere recital of her own adventures, but sees each lecture as an opportunity to break

Miss Flora Lockheed, daughter of the noted plane manufacturer, Allan Lockheed, christens the new "bullet-nose" Lockheed plane.

Self-starters of the electric or compressed-air type have made it possible for women to start a transport engine without assistance.

down the barriers of public apathy and distrust; to present flying, not only as a glorious adventure, but as an everyday logical development in our fast growing transportation system.

Miss Earhart's reserved, yet intense belief in the future of the industry, her capable and self-reliant manner, yet simple friendly approach to her audience — are the best arguments she could offer.

At the end of her lecture she said: "I will venture to make two prophecies, first that you who say you would refuse to fly today, will fly and find yourselves liking it within the next two years, and second, that many of you in this audience will live to fly the Atlantic on regularly scheduled airlines."

Although she is not planning to fly the Atlantic again "merely for the ride," she said she would do so, if it would demonstrate the value, or help to develop, some new equipment.

CHICAGO members of the Ninety-Nines, who have been holding informal meetings for the past year, have organized a local chapter with Ruth Kitchel Wakeman, transport 18221, as chairman, and Clayton Patterson, as general assistant.

With rumors that the National Air Races may be held in Chicago this summer (the 99's annual convention is always at the same time) and with another edition of the World's Fair in the offing, they plan to do their share for the Mayor's "Keep Chicago Ahead" committee, by playing hostess to the visiting flyers.

And if any of our readers, either men or women, will let us know when they are in the city . . . POPULAR AVIATION and *The Aero-Sportswomen* . . . will be glad to cooperate with the Ninety-Nines, or any other aeronautical organization such as the QB's, the

(*Concluded on page* 399)

Designing the Morvay "ALERTE"

by ANTON ALLAN MORVAY

Amateurs! Be sure to tune in on this series of articles in which Mr. Morvay starts in with the preliminary design of a light biplane and follows the calculations and details clear through to the finished design. You can't afford to miss one step in this development.

DURING the course of every light-plane fan's career, there comes sooner or later an overwhelming desire to build a high performance job; something different from the usual line of "home-made crates."

This desire seems to outweigh any question of the fan's ability to fly something really fast. In most cases, this point is secondary to the craving for building and owning a job that will "lick the spots off" of anything in its weight or power class.

Therefore, for the benefit of the amateur who gains a great deal of pleasure from merely building a job of this type, as well as the more advanced amateur who is actually capable of handling a ship at speeds exceeding 100 m.p.h., we will outline the various steps in the design, development and construction of a small plane to attain a certain speed with a given amount of power.

The idea of a light, comparatively low-powered airplane for attaining speeds of 100 m.p.h. or more is not new. To the writer's knowledge, there have been built and flown at least a dozen lightplanes that have done 100 m.p.h. or better, the outstanding one of which was the Heath "Baby Bullet" which was clocked at 132 m.p.h. on a closed course.

However, all these jobs were built for only one purpose—racing. As such, they could afford to be built the way they were, to get the last ounce of performance out of them. Of flimsy, stick-and-wire construction; with the cockpit, in most cases, built to suit the particular pilot who was going to fly it, these jobs were seldom good for more than a half dozen races.

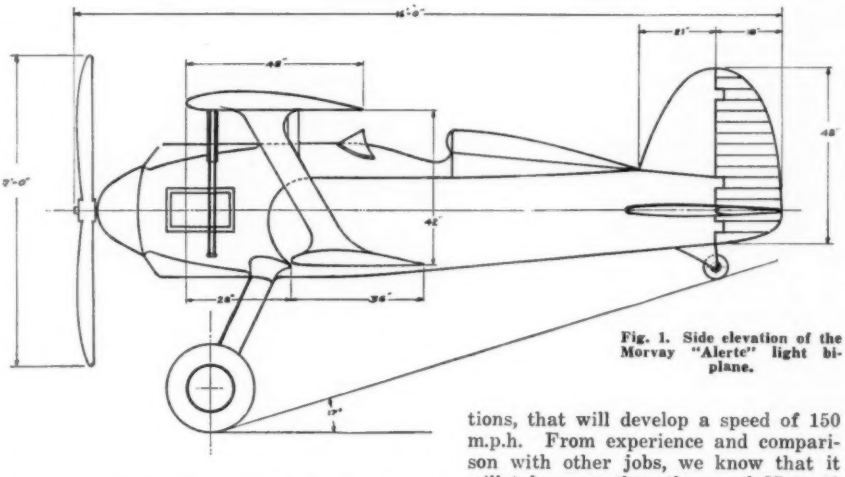


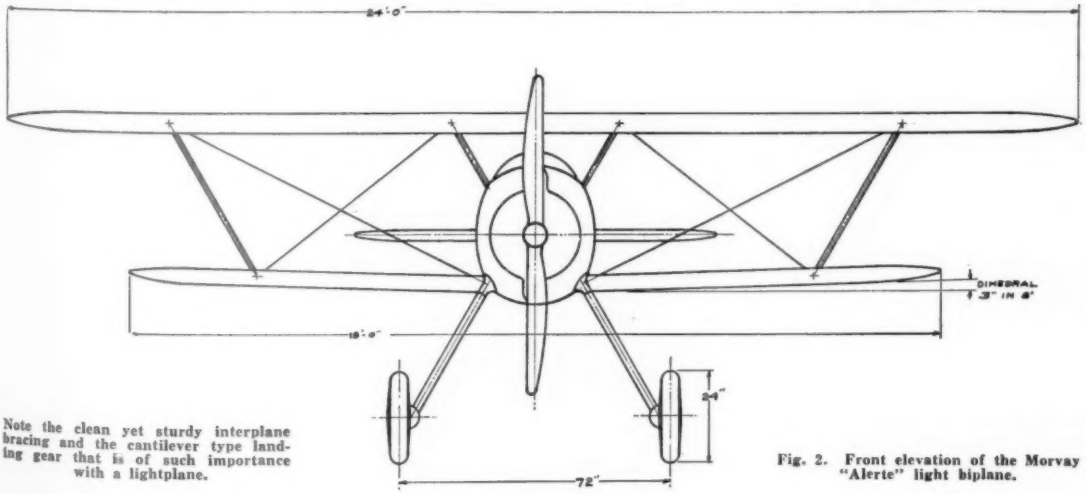
Fig. 1. Side elevation of the Morvay "Alerte" light biplane.

To build a lightplane that can stand the "gaff," day in and day out and under all conditions, with different sizes and "kinds" of pilots at the controls, is something altogether different. To withstand the indignities showered upon it by "ham" pilots, and for that matter good pilots who are not used to too highly maneuverable ships, and still come back every day and turn in anywhere from 125 to 150 m.p.h. a ship has to be built for stamina. Such is the problem that we are about to undertake.

For the sake of something to shoot at, suppose that we want to build a single-seater, of "man-size" proportions, that will develop a speed of 150 m.p.h. From experience and comparison with other jobs, we know that it will take more than the usual 25 to 40 hp. used on the average lightship to chalk up this speed.

First of all, we must set up some basic figures to work from. These are usually known as "service requirements." This simply means that we must put down on paper the various things that we want the ship to do in the way of top, cruising and landing speeds, how much gas and oil we want to carry, allowable weight for the pilot, etc., etc. These figures, of course, are for estimating purposes only. They may or may not be achieved in the actual airplane but the necessary corrections can be made later.

Putting them down in order, let us say, for instance, that we have the following requirements to meet; that is, we will have to work out our design so



Note the clean yet sturdy interplane bracing and the cantilever type landing gear that is of such importance with a lightplane.

Fig. 2. Front elevation of the Morvay "Alerte" light biplane.

as to approximate these figures as closely as possible:

PERFORMANCE

High speed	150 m.p.h.
Cruising speed	100 m.p.h.
Landing speed	50 m.p.h. or less

LOADING

Pilot (with parachute)	200 pounds
Gasoline (10 gallons)	60 pounds
Oil (2 gallons)	16 pounds
Total disposable load	276 pounds

Maximum power allowed, 100 hp.

With these figures at hand, we can continue on to arrive at a preliminary estimate of the gross weight of the airplane. (Total weight in the air.) Composite figures, taken from several dozen existing types of sportplanes, indicate that on a wide average it is safe to assume the gross weight as being between 3 and 4 times the weight of the disposable load. This applies to lightplanes of modern design, of clean construction and good efficiency.

For the time being, let us say that our gross weight will be 828 pounds (disposable load of 276 × 3). This weight, minus the disposable load of 276 pounds, gives us 552 pounds as the net weight of the ship, empty.

The primary consideration in this design is speed. However, while there are numerous ways of attaining a high velocity with an airplane, the easiest and most popular method, that of increasing the motive power, is unavailable to us, as we are limited to a maximum of 100 hp. Therefore, we must look elsewhere for any possibilities of realizing the maximum speed desired.

The fact that we are given 100 hp. to use on this job, more or less, puts it out of the pure "lightplane" class insofar as the full definition of the word goes. The Department of Commerce classification of a lightplane is:

A heavier-than-air aircraft of less than 1,000 *pounds gross weight, with a maximum wing loading of* 5.5 *pounds per square foot, and having at least* 5 *square feet of wing area per engine horsepower. When equipped with engines of an approved type, airplanes of less than* 1,000 *pounds gross weight may be classed as lightplanes, if the wing loading does not exceed* 6 *pounds per square foot and the ratio of wing area to horsepower is less than* 4.

Taking the gross weight of 828 pounds and dividing by 5.5, we get 150 as the number of square feet of wing surface. Then, in turn, dividing 150 square feet by 100 horsepower gives us a ratio of 1.5 or in other words, 1½ square feet of wing area per horsepower, which is below the minimum given by the D. C. classification.

Dividing the gross weight by power we get a value of 8.2, or 8¼ pounds per horsepower as the power loading. This gives us three of the four most important factors governing airplane design, namely, gross weight, wing area and power.

The fourth and deciding factor is parasite resistance. A dozen airplanes may all have the same weight, area and power, and yet each may have a different top speed. The answer is Parasite Drag, which is the next thing to estimate.

To work out any intelligent figures with reference to parasite drag, however, we must have a general idea of what the proposed airplane is going to look like, particularly from the standpoint of area exposed to the airflow. This information is usually obtained by making up a preliminary three-view sketch of the project. To do this, we must work up some definite figures as to dimensions and structural considerations.

Taking the wing area of 150 square feet, we must resolve that into a wing or wings of the most efficient proportions. All matters considered, we will find that a biplane form of wing arrangement is the most practical for a job of this type. Structurally, it is superior to a monoplane. Aerodynamically it is equal.

From personal experience, together with that of others, combined with the findings of much wind tunnel work, we find that the most efficient arrangement of the two wings is to divide the total area as follows:

Upper wing	60%
Lower wing	40%

This gives us 90 square feet for the upper wing and 60 square feet for the lower.

Then, using an aspect ratio of 6, we get a span of approximately 24 feet and a chord of 4 feet for the upper, and a span of 18 feet with a corresponding chord of 3 feet for the lower. Allowing the gap be equal to one-half distance of the two chords combined (4 plus 3 = 7) we have a gap of 3½ feet or 42 inches. Placing the lower wing back a distance equal to one-half the upper chord, we have 2 feet or 24 inches of stagger.

To get proper longitudinal control, we make the effective tail length (distance from center of gravity to rudder post) equal to three times the mean chord (upper chord plus the lower chord and divided by two). In our case the values 4 + 3 = 3½ × 3 = 10½ feet tail length.

The size of the horizontal tail surfaces may be approximated as being 20 percent of the total wing area (depending on the tail moment and other factors). This, of course, will give us 30 square feet which is distributed and arranged so that we have a stabilizer span of 1/3 the wing span, making it 8 feet.

Then, again, we use the 60/40 proportions in distributing the area; giving the horizontal stabilizer the sum of 12 sq. ft. and the elevators 8 sq. ft. The vertical surfaces can be assumed to have 50 percent of these values, i.e. vertical fin = 6 sq. ft. and rudder 4 sq. ft.

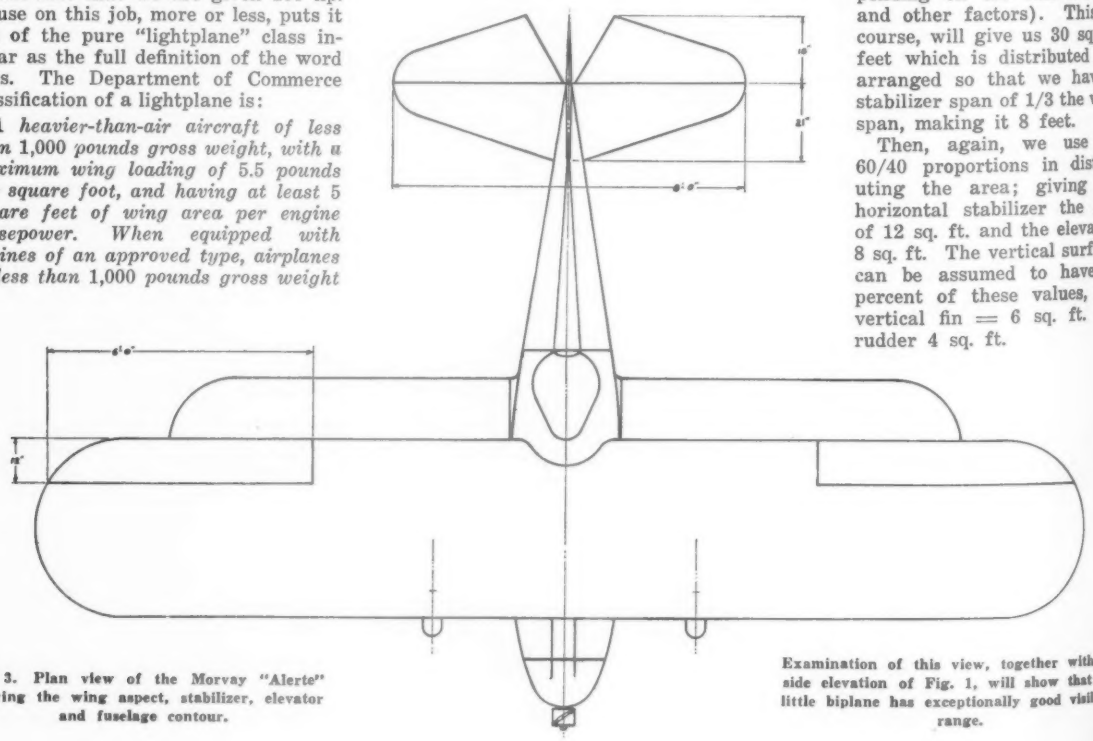


Fig. 3. Plan view of the Morvay "Alerte" showing the wing aspect, stabilizer, elevator and fuselage contour.

Examination of this view, together with the side elevation of Fig. 1, will show that this little biplane has exceptionally good visibility range.

A Homemade Smoke-Tunnel

by A. L. DOUGLAS

A novel and inexpensive method of studying aerodynamics at home by observing the air flow about model wings, fuselage and similar objects. Errors in streamlining are quickly observed.

THE IDEA of using a smoke stream, to make visual tests of airfoils, was suggested by the curling of a wisp of cigarette smoke around vertical ornaments on a reading lamp.

The first crude experiments were conducted by suspending a small scale model directly over a lighted cigarette. This had obvious disadvantages. Even in a closed room there were air currents that interfered with the smoke stream and prevented a steady flow of smoke over the airfoil.

Then it was found, that at the slow speed at which smoke rises in free air, the smoke had a tendency to cling to the object being tested. This defeated the purpose of the experiment, which was to observe the actual airflow around the various parts of the model, the smoke being used to make the air movement visible.

When I was satisfied the idea had possibilities, I set about devising means of producing and regulating a vertical draft to carry smoke at variable speeds without lateral disturbance. The result was a rectangular tunnel 5 in. x 10 in., cross-sectional dimensions and 36 inches high, having glass observation windows just opposite each other in the narrow sides and placed about eight inches from the bottom of the tunnel.

Two crossbars, on which to rest the leading edge of airfoil to be tested, were inserted just above the lower edge of the windows. Slightly above these was placed a transverse push bar by means of which the angle of incidence of the foil to the smoke column could be varied. The flue effect of the twenty-two inch extension above the observation windows gave the smoke column directional stability and sufficient speed to show up faults in streamlining.

In order to determine more definitely the probable performance of a given model, it was necessary to install an adjustable damper, (Fig. 1) with a gauge showing the degree of opening,

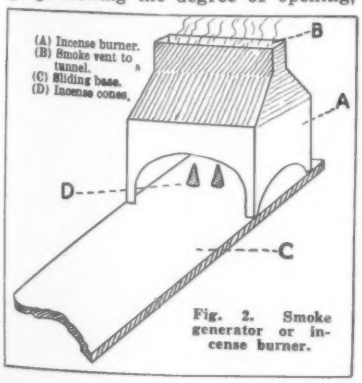


Fig. 2. Smoke generator or incense burner.

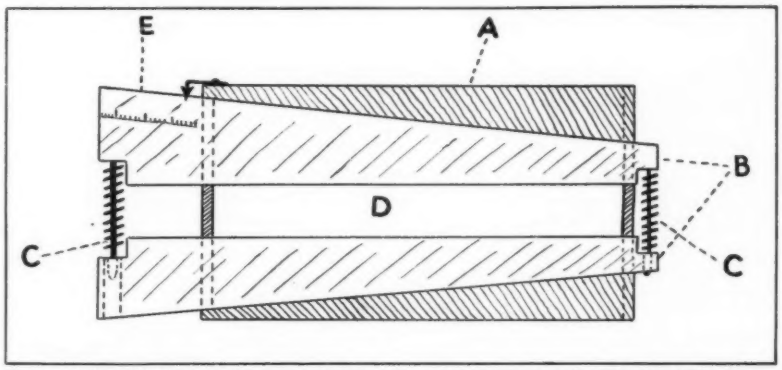


Fig. 1. Adjustable damper for smoke-tunnel. (A) is the smoke-tunnel; (B) adjustable damper slides; (C) damper springs; (D) open smoke channel; (E) damper gauge or scale. When withdrawn toward the left, the channel opening increases.

near the top of the tunnel. A small exhaust fan was placed just over the damper.

This combination made it possible to accurately regulate the airflow through the tunnel. A specially constructed incense burner (Fig. 2) was attached to a sliding bar in the bottom of the tunnel to facilitate testing the different parts of the model without disturbing the model. Ordinary perfume incense cones make a satisfactory smoke supply.

The density of the smoke column is regulated by increasing or decreasing the number of incense cones in the burner. One or two cones are ample to make streamline tests but when the exhaust fan is operating and speeding up the smoke flow to create lift and other performance tests, it is necessary to materially increase the amount of smoke to insure a clearly visible stream over the airfoil.

By testing scale models of known performance at varying angles of incidence and rates of smoke flow, anyone who has a working knowledge of the principles of aerodynamics soon is able to plot a reasonably accurate performance graph of any model tested.

Lacquered balsa scale models are ideal for testing purposes inasmuch as they are easy to make, inexpensive and can be altered in form if the original does not come up to expectations.

Damper gauge readings are made at the stage of airflow when the smoke first breaks away from the curved upper surface of the wing model. This occurs at lower air speeds on thick wing models than it does on thinner designs of wings. This makes the plotting of a performance graph a mere matter of comparison.

By the use of a portrait lens it is possible to take photographs of the smoke screen with an ordinary camera, this being of value as a permanent record or in making a more careful study of the stream-lines. A flash light must be used, or the arc from a quickly opened electrical circuit, as it is manifestly impossible to make a time exposure of the rapidly moving stream.

Examples of smoke-tunnel photographs will be found in "Practical Lessons in Aviation," page 377 of this issue. These photographs were taken by the National Advisory Committee on Aeronautics in their large tunnel and show conclusively the nature of the air-stream circulating about the airfoil at different angles of attack. This is an excellent guide to the design of an airfoil and by the means described here can be accomplished at little expense.

One of the most amusing experiments is to build a complete model airplane in such a way that it can be easily dismantled. Then, the interactions and reactions of the various parts can be studied by removing one or more of the elements. Thus, we can observe the effects of downwash from the wings, the influence of the fuselage on the tail-group and other factors.

It is here that we best observe the effect that one part of the plane might have upon another, the "shading" of the tail group by the fuselage and the vortices thrown to the rear that affect the stability of the ship. The action of the stream around a revolving propeller is also highly interesting, particularly the nature of the inflow around the tips of the blades.

And while it does not give the definite data obtainable by using a wind tunnel it does furnish the amateur experimenter a means of checking up on his models and can probably be used to advantage by the commercial airplane designer.

What Our Readers Are Building

A department devoted to our readers' activities in airplane, glider and engine construction, showing the latest developments.

And Here's All About Them

AT the top of the list is the Retz R-8 biplane built by Robert Retz, Farmland, Ind. At first glance one would say that it looks like a Curtiss pursuit job with cylinder fairings, spats and everything complete.

Mr. Retz states that he has been working on this type of biplane ever since 1928 and in that time has built three different ships, each with a different engine. He has not given us much information on its performance for we are considering giving more complete details in the future, including the drawings and specification.

Second, is the "Dixie Special" developed from Russell plans by C. A. Hughes, Jr., Elon College, N. C. When the original Russell was finished and tried out, it was found that the landing gear was too weak and this was rebuilt into a split axle type. The fuselage was then reinforced, the rudder was set higher and a 6-foot prop was substituted for the 5-foot prop.

In the second series of trial flights it would fly itself off the ground, and even at that, the take-off distance is less than that with an OX-5 job. Lacy Cooper, the test pilot said that it was suprisingly stable for such a small ship and that he estimated the landing speed at from 40 to 45 m.p h. with a top speed of 100 m.p.h.

A steel tube fuselage is employed with the tail surfaces also built up out of tubing. The span is 23'-9" with a 46 inch chord. The wing section is the Clark "Y". Total length is 15'-0". Completely equipped with the 45 h.p. Szekely engine it weighs about 600 pounds.

At the bottom of the column of pictures is the hot looking little biplane constructed by Glen A. Smith, 8320 East Six-Mile Road, Detroit, Mich. The wing arrangement, together with the "V" type interplane struts reminds one of the wartime Nieuport scouts. Yes—it is driven by a Ford engine which is cowled by a well streamlined hood and has the radiator well placed near the bottom of the nose. Just how this works out in the way of resistance is not known at this writing but it would seem a better disposition of the radiator problem than on many other Ford powered ships that we have seen.

Because of the short chassis, which brings the lower wing quite close to the ground, it would seem that all possible advantage is taken of the ground compression effect in gaining a low landing speed.

Take a Look at These Fine Lightplanes

Here we have the Retz R-8 biplane which has all of the snap and dash of a pursuit ship, but on a small scale. And its performance is not behind its appearance at that.

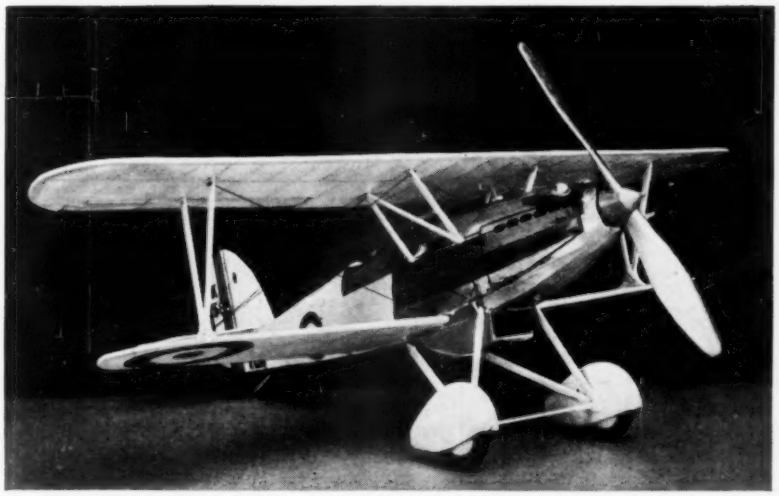
This is the "Dixie Special", a fine looking little parasol monoplane that is complete down to the insignia. It is powered with a 45 h.p. Szekely engine and has an estimated top speed of about 100 m.p.h.

Glen A. Smith is the author of this snappy looking little Ford powered job. The arrangement is somewhat unusual for a Ford powered biplane and shows originality on the part of Mr. Smith. Note the "V" type interplane struts.

Building a Hawker "Super-Fury"

by
PAUL W. LINDBERG

Model editor and model designer of
POPULAR AVIATION.



Mr. Lindberg's experimental model of the Hawker "Super-Fury" is one of the most beautifully finished models that we have seen. It is also an excellent flyer.

HERE is a model all you model builders have been waiting for —the Hawk Super-Fury. The Super-Fury is a single-seated pursuit biplane, reputed to be one of the fastest planes in the world.

This outstanding model has been designed and test flown by our experimental department, and its performance is amazing. Flights of five hundred feet, or over, are nothing unusual for this model.

We are proud to present to the model builder a new and improved type of shock-absorber, which will eliminate any fear of washing out the landing gear. Note how cleverly it is fitted into the fuselage. Again, the control surfaces are adjustable, being fitted with aluminum hinges, an exclusive feature of ours.

If you wish a larger model, multiply these measurements by the required ratio of increase. The color scheme can be obtained from the cover of this issue.

CONSTRUCTION OF FUSELAGE

Construct one side at a time, first placing a sheet of ordinary wax paper over the plan to prevent the cement from sticking to the plan. The longerons, vertical and diagonal braces, etc., are held in place until securely cemented, by inserting straight pins on either side of strips.

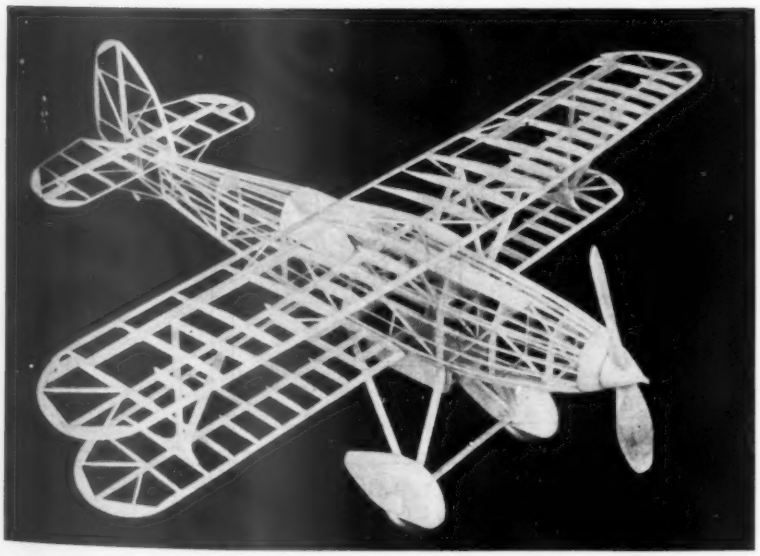
After the two fuselage sides are completed, they are pinned to the top view of the plan in such a manner that the top longerons face down, and the sides are at right angles with the table. The cross members are now cemented in place, forming a rectangular fuselage. The formers are traced with carbon paper on the 1/32 inch sheet balsa and then carefully cut out with a razor blade.

The nose piece is cut from a 3/8 inch thick block and cemented squarely to the nose of fuselage. The formers are now cemented in position designated in side view of fuselage by corresponding identification numbers. The 1/16 x 3/32 inch balsa fairing strips are cemented into position and a small piece of cowling paper is cemented to cover the space between F-5 and F-6, after having first cut out section to represent cockpit. Cut troughs in balsa blocks. These are cemented into position and are carefully cut and sanded to confirm with stringers on either side.

LANDING-GEAR

That part of the landing-gear containing the shock-absorber is made up of .022 piano wire formed as shown in front view. The method of attaching the shock-absorber to the fuselage is clearly shown in the plan. Attach rear struts to piano wire, which pass through bead bushings, cemented to wing support beam.

After the streamline wheel coverings have been carved and sanded to shape, they are cemented to the lower ends of the landing gear struts. The wheels are now placed in position, with an axle passing through both wheels and wheel coverings.



The framework of the Hawker "Super-Fury" before covering, shows that the construction is comparatively simple and easily made.

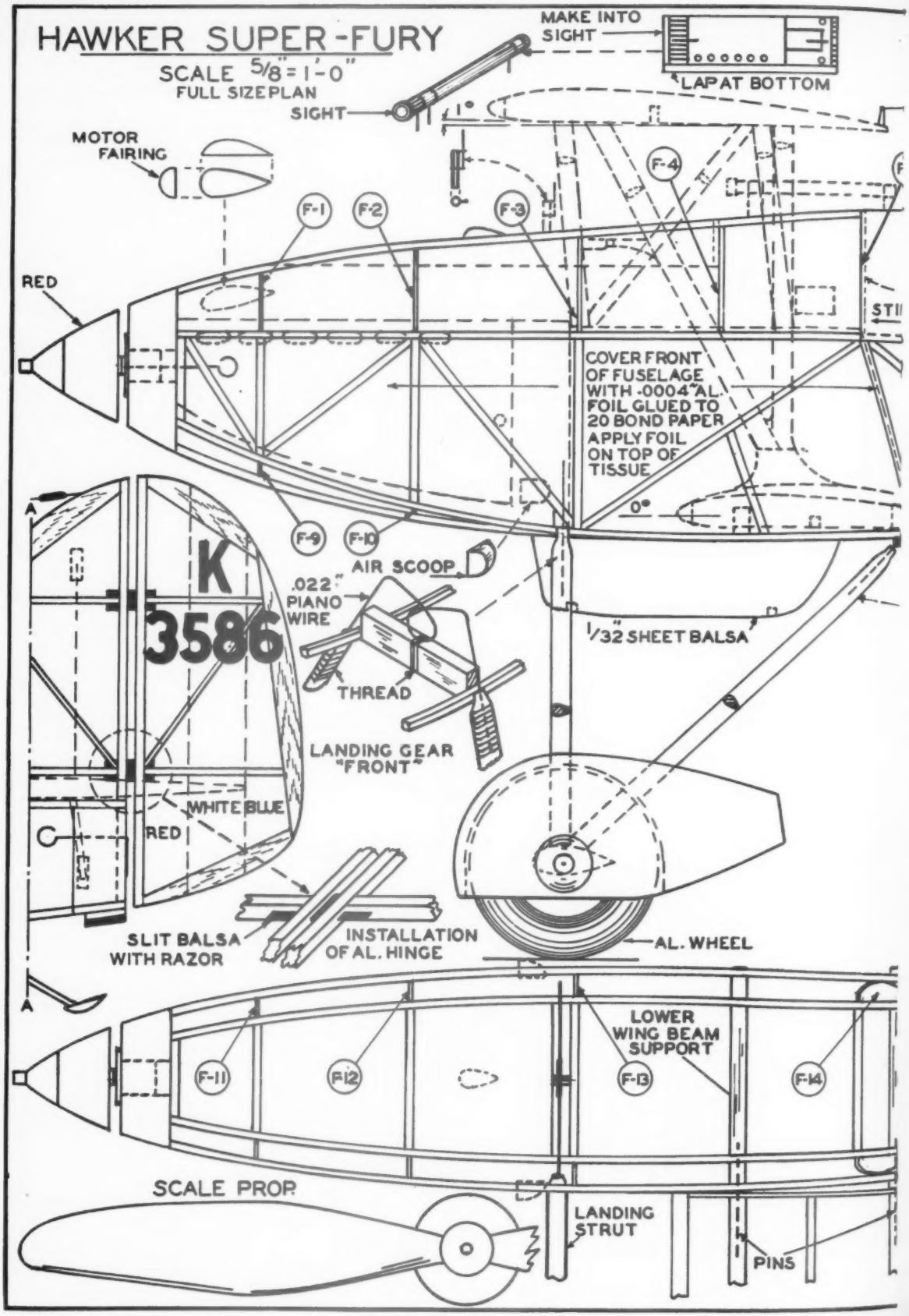
RADIATOR

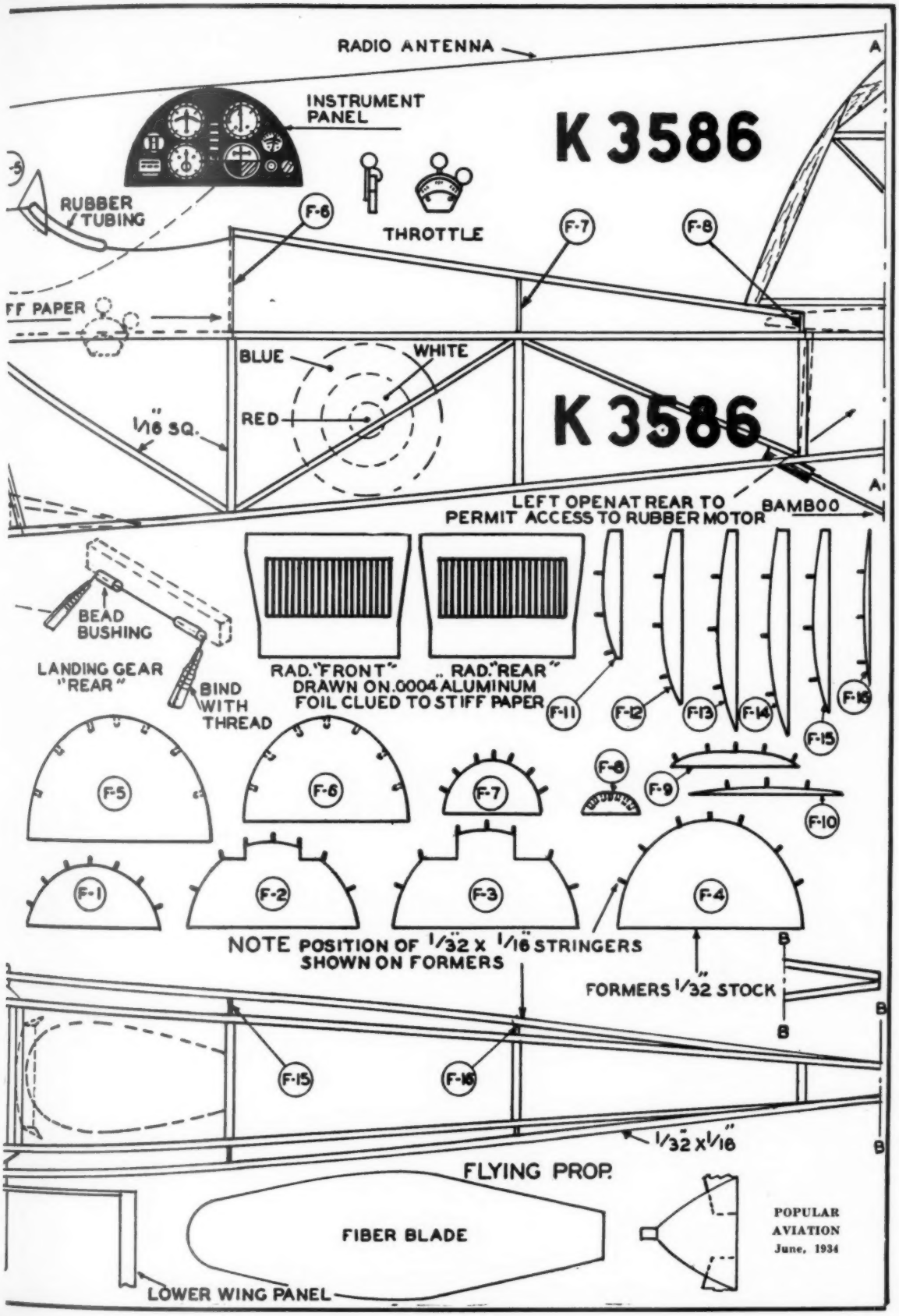
The radiator sides are cut from 1/32 inch sheet balsa. After the two sides have been built, they are cemented to the bottom longerons of the fuselage. Cross-members are now cemented at both front and rear, completing the taper effect. The front and rear of the radiator are made of a heavier grade of .0004 inch aluminum foil, 20 lb. bond paper on which vertical lines have been drawn to represent radiator shutters.

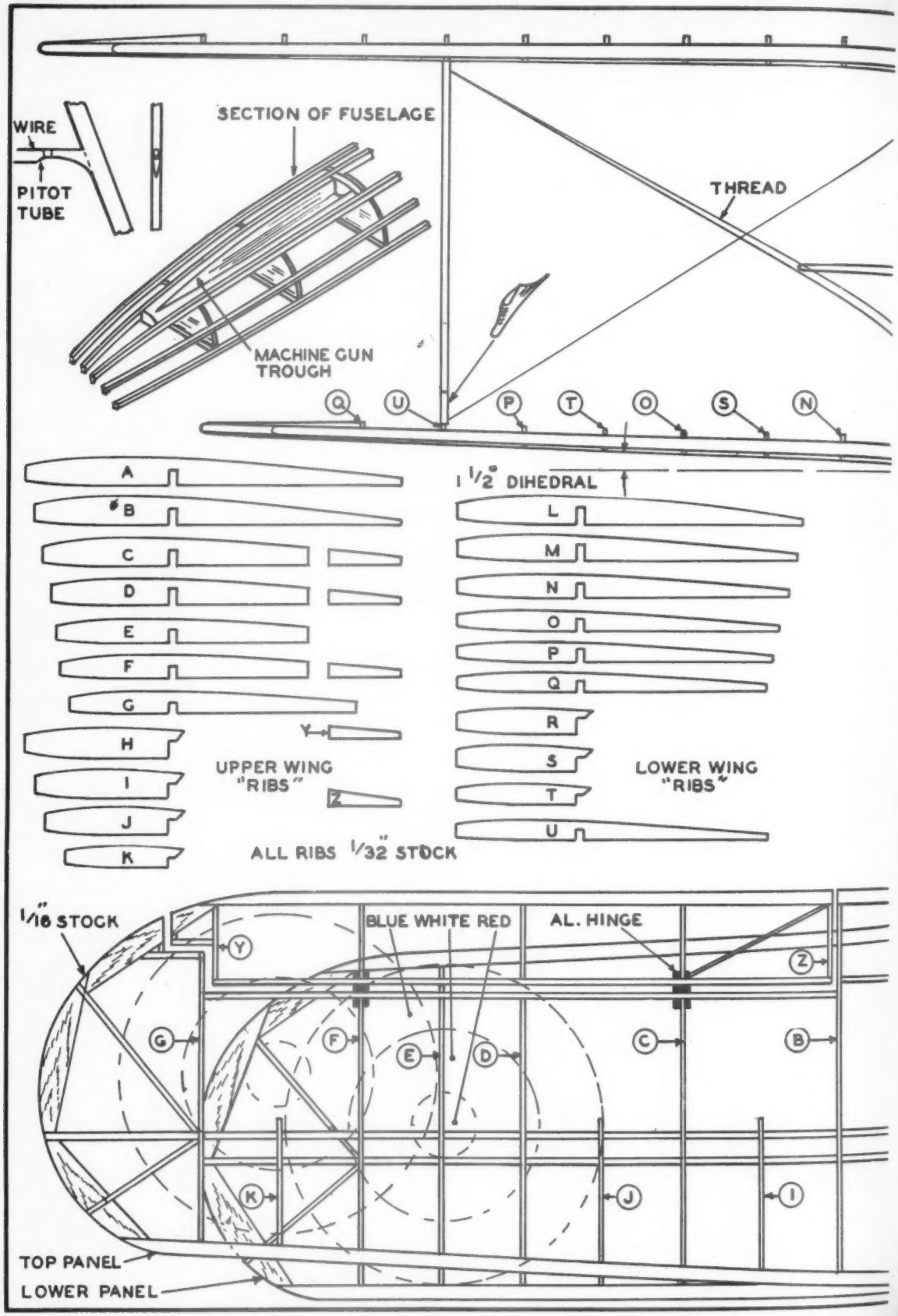
WINGS

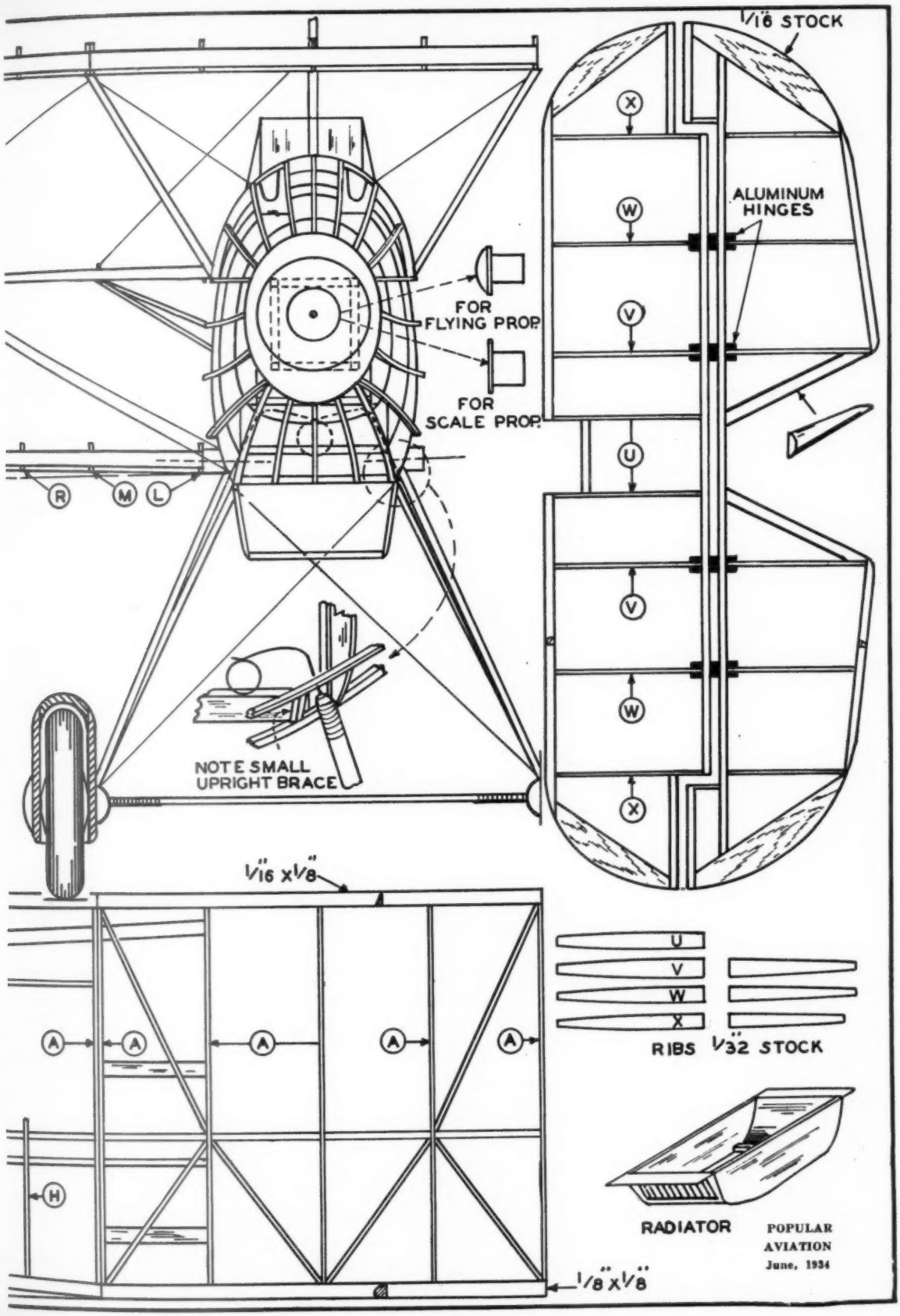
Make both upper and lower leading edges of the wings from 1/8 x 1/8 inch balsa. The trailing edges are made from 1/16 x 1/8 inch balsa. The upper wings, which are made in three sec-

(*Concluded on page* 392)


HAWKER SUPER-FURY
SCALE 5/8" = 1'-0"
FULL SIZE PLAN
MAKE INTO SIGHT
LAP AT BOTTOM
SIGHT
MOTOR FAIRING
F-1
F-2
F-3
F-4
RED
COVER FRONT OF FUSELAGE WITH .0004" AL. FOIL GLUED TO 20 BOND PAPER APPLY FOIL ON TOP OF TISSUE
1°
0°
F-9
F-10
AIR SCOOP
.022" PIANO WIRE
THREAD
1/32" SHEET BALSA
K
3586
LANDING GEAR "FRONT"
WHITE BLUE
RED
SLIT BALSA WITH RAZOR
INSTALLATION OF AL. HINGE
AL. WHEEL
LOWER WING BEAM SUPPORT
F-11
F-12
F-13
F-14
SCALE PROP
LANDING STRUT
PINS


RADIO ANTENNA
INSTRUMENT PANEL
K 3586
RUBBER TUBING
THROTTLE
F-6
F-7
F-8
FF PAPER
BLUE
WHITE
RED
1/16 SQ.
K 3586
LEFT OPEN AT REAR TO PERMIT ACCESS TO RUBBER MOTOR
BAMBOO
BEAD BUSHING
LANDING GEAR "REAR"
BIND WITH THREAD
RAD. "FRONT" RAD. "REAR"
DRAWN ON .0004 ALUMINUM FOIL CLUED TO STIFF PAPER
F-11
F-12
F-13
F-14
F-15
F-16
F-5
F-6
F-7
F-8
F-9
F-10
F-1
F-2
F-3
F-4
NOTE POSITION OF 1/32 X 1/16 STRINGERS SHOWN ON FORMERS
FORMERS 1/32 STOCK
F-15
F-16
1/32 X 1/16
FLYING PROP.
FIBER BLADE
LOWER WING PANEL
POPULAR AVIATION
June, 1934


WIRE
PITOT TUBE
SECTION OF FUSELAGE
MACHINE GUN TROUGH
THREAD
Q
U
P
T
O
S
N
A
B
C
D
E
F
G
H
I
J
K
Y
Z
UPPER WING "RIBS"
1 1/2° DIHEDRAL
L
M
N
O
P
Q
R
S
T
U
LOWER WING "RIBS"
ALL RIBS 1/32" STOCK
1/16" STOCK
BLUE WHITE RED
AL. HINGE
TOP PANEL
LOWER PANEL


1/16 STOCK
X
W
V
U
V
W
X
ALUMINUM HINGES
FOR FLYING PROP
FOR SCALE PROP
R
M
L
NOTE SMALL UPRIGHT BRACE
1/16 x 1/8
A
A
A
A
A
H
1/8 x 1/8
U
V
W
X
RIBS 1/32 STOCK
RADIATOR

Super-Fury Model

(*Continued from page* 387)

tions namely, left, right and center, are first built. Lay a sheet of wax paper on plan and pin center spar into position. The ribs are next placed in an upright position at their proper locations, and then cemented.

The leading and trailing edges are now cemented into place. The wing tip is made from 1/8 inch sheet balsa. After the three sections have been completed, block up both left and right sections, so that they have a dihedral angle of 1½°. The balsa compression members are now cemented into place. The lower wings are left and right sections, built in the same manner as the upper wings, excepting for the center section.

The section of lower left wing is shown on the plan with the wing support beams, which are made of 1/8 x 1/4 inch balsa, containing pins. These pieces are inserted into balsa beams in fuselage to receive the wing.

ELEVATOR AND RUDDER

The ribs are cut from 1/8 inch sheet balsa and placed in an upright position. The spars are made and cemented to ribs at their proper locations. The spars are tapered from tip to tip. The leading and trailing edges of elevator are made from 1/8 inch square balsa.

CABANE STRUTS

The cabane struts are made from 1/8 x 1/8 inch balsa. Cut these struts to proper length and cement to top longerons as shown on the plan. Hold struts at proper angle until cement becomes thoroughly dried.

COVERING

In covering fuselage, to obtain best results, cover in strips one to two fairings in width, on the top. On the sides and bottom, the strips may be wider, owing to the flatter surface.

Do not cover the section on the underside of fuselage between the nose and former F-9. This space is left open to receive lead used to balance the ship. The radiator is covered on bottom and two sides. The entire front of fuselage, working back to cockpit is covered with .0004 inch aluminum foil 20 lb. bond paper. Cut into strips and apply over tissue covered fuselage.

The upper wing may now be covered. The top is covered in three sections, the two outer sections being covered first. The top covering of the wings (upper and lower) need not be fastened to each rib, but only to the wing tips, leading and trailing edges. The stabilizer is covered on both sides, fastening covering only to leading and outer edges. The rudder, too, is covered on both sides.

Using a small water color brush, give the entire fuselage covering a light coat of water. This will cause paper to tighten, smoothing out all wrinkles.

(*Continued on page* 412)

The Auxiliary California P. A. Contest

by TERRENCE VINCENT

(Junior Aero Dept., Radio Station KFI)

WHEN we learned of POPULAR AVIATION'S great contest for builders of scale model airplanes, featuring replicas of the Boeing 247, permission was granted to tell about it many times on my KFI radio broadcast. While we have no active part in this wonderful contest, we take pleasure in telling about it.

Cooperation of United Air Lines, through the Los Angeles office, was invited to further the interest in Southern California and George L. Strehlke, traffic manager, obtained five additional prizes—one round-trip flight to San Francisco, and four round-trip flights to San Diego, all originating or ending at this airport.

Further, to stimulate interest, Walker's Glider Club at 501 South Broadway, with its more than 20,000 signed adherents, had posters loudly proclaiming the POPULAR AVIATION prize list, the local additional prizes and the KFI radio broadcasts.

All of this was no part of the contest, yet all had pleasure in telling the news concerning it. Now comes the time for prize giving and prize acceptance.

Mr. Strehlke, traffic manager for United Air Lines and with offices in Los Angeles, is sending out letters to the privileged passengers, advising them how to proceed to get their tickets and trips.

On March 20, my KFI broadcast included excerpts from letters sent by Eugene O. Clay of Pomona, second prize winner; M. Charles Farrell of Glendale, and Conrad Nelson of San Diego. Jimmy Gillum called to see me, and his quotations are also quoted. No word has arrived as yet from Vernon Tuell of Riverside, nor from P. T. Bannerman of San Bernardino.

The winners in the great 1933 scale model airplane contest, for Southern California, are being notified by the airline company this week. Generally, the winner just needs to present himself at the company office in Los Angeles or San Diego, and the round-trip flight will be arranged at once. Records of this contest are with all officials who may meet these fine winners. And now for news from the winners as announced from KFI.

* * *

JIMMY GILLUM, Los Angeles, one of the winners of a Los Angeles-San Diego flight, wants to know if he can transfer the flight to his charming wife. We'll refer Jimmy to the manager, Mr. Strehlke, for that answer. He did not say whether *he* wants to keep both feet on Mother Earth while *he* flies, or if he is just being husbandly generous when he gives this *wife* this trip.

* * *

FROM San Diego comes this work from Conrad Nelson:

"With all the world agog over aviation, it would be strange if I didn't get caught in the enthusiasm. So when I saw this offer to win a ride in a multi-motored transport, I started working on a model for the contest. I have been working on models about a year and have made a fairly good showing in contests held here. I have never worked on anything so interesting as the one which gained for me this flying prize. I surely was surprised and happy when I received the card telling me of winning a round-trip flight between San Diego and Los Angeles."

* * *

FROM Pomona comes word from Eugene O. Clay, second prize winner, who won a 3000-mile flight, as a reward for his excellent work. He is not with us, but sends this information:

"A contest, such as that recently staged, is of value in many ways—to the sponsors and to the participants. FIRST, I consider this contest better than most contests because it was unlimited as to qualifications of entries, materials, and the extent to which workmanship and ingenuity could be carried. Many contests lose their value because they specify the use of balsa-wood or model kits and thus discourage originality!

"Second, I believe a great many people have been sold on the advantages of air travel through the contest. During the construction of my model, the many persons examining it have not known previously that airplanes existed with such conveniences and comforts.

"Last, but not least, is the knowledge of the new types of airplanes necessarily gained by the model builder. I know that I have become familiar with every part, material, types of construction, and mechanical operation of this twin-motored '247' as well as other contemporary types.

"I think there is nothing much better than a well-planned model airplane contest to spread information, interest, and knowledge of aviation."

* * *

AND from Glendale comes word from M. Charles Farrel, of my Glider Club, who is one of the winners. He says:

"I thank you, Mr. Vincent, for the invitation to tell our many friends over KFI of the joy in winning a prize. I think it is a great feeling to be among the winners. This, however, is only one of the pleasures in model making.

"I have been a model builder for many years and expect to continue for a great many more. I believe it to be one of the greatest hobbies that a boy or young man can have. I think model contests encourage us to do better work. They teach accuracy, neatness, and above all bring us together in a spirit of good fellowship which, in reality, is the foundation of all worthwhile hobbies."

* * *

SOUTHERN CALIFORNIA did well in this contest and we are proud of her success. We have a lot of enthusiasm among our model builders in this part of the country and a lot of hard workers.

What the Industry is Doing

News flashes from the aeronautic industry boiled down into a nutshell. Contributions to this department are solicited from manufacturers, schools and airports.

DOWMETAL, which was featured in the recent stratospheric flights, is made in a number of different grades for different purposes. This is the lightest known alloy that is practical for everyday service, and can be supplied as sand castings, die castings, extruded shapes, forgings, sheet, plate or strip. It is very easily machined, and the saving in machining alone sometimes shows lower cost than equivalent parts made from cast-iron. A new data book on Dowmetal, for the use of engineers, can be had from The Dowmetal Division of the Dow Chemical Company, Midland, Mich.

SERUM, required for breaking up an epidemic of typhoid fever at San Diego, Calif., was shipped by Air Express from New York, in less than one day.

WHEN the refrigerating plant of the Armour plant in South Omaha, Nebr., broke down, it was necessary to rush replacements for the machinery to avoid the spoiling of a large stock of meat held in the coolers. The casting was shipped from Milwaukee, Wis., a distance of 510 miles in four hours and 18-minutes.

A RECORD for air shipments of bulky materials was broken recently when a large transport plane was completely filled with more than 1200 dresses, suits and coats that were flown from New York to Chicago. This is the heaviest consignment ever handled by the Air Division of the Railway Express Agency. The wearing apparel weighed 2400 pounds.

THE TWA Douglas Airliner recently established a transcontinental transport plane speed record, between Los Angeles and New York, of 13 hours, 2 minutes.

THE ARUP, the new flying-wing plane invented by Dr. C. L. Snyder, has been placed in production in a factory at South Bend, Ind. Ralph H. Graichen, chief engineer, has introduced novel refinements into the construction of the Arup which is now more compact and trim than before. It has a span of 16 feet, overall length of 16 feet 4 inches and is powered with a 40 h.p. engine. The top speed is 90 m.p.h. and the landing speed is about 20 m.p.h.

LORENZEN Propeller Co., Niles, Mich., has attained great renown among amateurs, homebuilders and experimenters because of the excellent props that they have and are producing. The Lorenzen Propellers are of laminated birch construction, tipped with a combination of brass and monel metal. R. E. Lorenzen says that the company has enjoyed a fine business all winter and that it is already being rushed with spring orders. Many of our readers will be interested in the new Lorenzen propeller circular, just issued, which will be mailed for 10 cents.

MEALS can be ordered from the air by radio, a late convenience offered by the Transcontinental and Western Air to its patrons. Before arriving at passenger terminals, a printed menu is handed to each passenger, the meal is selected and ordered over the plane's two-way radiophone. On his arrival, the passenger finds the hot dinner or lunch awaiting him at the station. This new service replaces the ...ner practice of serving meals on board and ...uits, therefore, of a greater variety of food.

The Vacuplane which has had successful flights.

ANTHONY H. G. FOKKER'S company, Amsterdam, Holland, has been granted a franchise for the sales and distribution of all the Lockheed models. The franchise covers all European countries except Switzerland. A special agreement permits the sale of only the Electra to Russia.

SUCCESSFUL test flights made with the Knight Twister lightplane, have made this little ship very popular in and around Chicago. It will be remembered that the original plans of the original Knight Twister were published in POPULAR AVIATION some months ago.

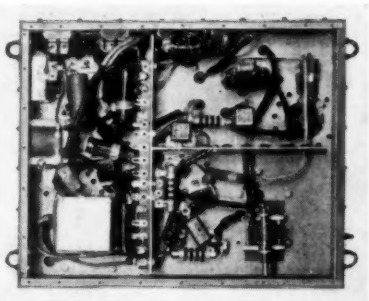
A NEW commercial non-skid tread type of commercial airplane tire, made by the Firestone Tire and Rubber Company in the 15.00-16 and other sizes, is now available. It was developed and tested on the two Ford transport planes owned by the Firestone company.

AMERICAN Airways placed new 15 passenger Curtiss Condors on their New York-Boston run, the new ships reducing the time on this run by 29 minutes.

Special condensers for Electrodrome fog dispeller.

THE new Beechcraft, on its recent test hops, showed a top speed of 175 m.p.h. It is provided with a 225 h.p. Jacobs engine and has a retractable landing gear. It is of the cabin biplane type with a novel system of interplane bracing.

TO BRING flying within the means of a greater number of people, the Safair Flying School, Roosevelt Field, has introduced a new popular priced flying course which provides all of the instruction necessary for flying solo. Instruction is given in Curtiss Fledgling planes equipped with Challenger engines. While this course will not qualify for a pilot's license it will gratify the desire of many people to solo who cannot afford to enroll in a more expensive course at the present time.



Bottom of new Lear Transmitter.

JOHN LIVINGSTON, the famous racing pilot and winner of many major air races, has been employed by the Waco Aircraft Company, Troy, Ohio, in their engineering department. Whether this is an intimation of Waco entering the racing game or whether Livingston has given up racing, is only known to a few and they won't tell. But anyhow, it's a fine hookup.

A NEW Boeing pursuit ship, equipped with an enclosed cockpit and retractable landing-gear, the first of its type, has been delivered to the Material Division, U. S. Army Air Corps, Wright Field, for performance tests.

NONSOL, a new rubber compound that is insoluble in gasoline or lubricating oil, is now being used in the manufacture of push-rod gaskets by Air Transport Equipment, Inc., Roosevelt Field, L. I., N. Y. They have been tested by a large airline on Wasp engines and have proved satisfactory.

SLEEPING berths have been installed on six Condors of the American Airways. Each ship is supplied with a dozen full-length berths. To our mind this announcement is of just as much importance as the announcement made 50 years ago when the railroads put on sleeping cars as regular equipment.

NEON Flasher lights for airports have been developed by the Lakewood Engineering Company, Columbus, Ohio, which have been approved by the Department of Commerce. These lights have many advantages. They operate at low cost, are portable and require no cables, wiring nor conduits. The flashing lights are operated by a 6-volt current from Low-Drain Willard Storage batteries at a cost of from one to two cents per day. They may be furnished in either red or green and are ideal for boundary lights.

A REPORT to the stockholders of The Waco Aircraft Company, Troy, Ohio, states that the net profit of the company, as a percentage of sales increased to 6.95 percent. from 3.11 percent. of the previous year. The net manufacturing profit for the year is shown at $253,325.19.

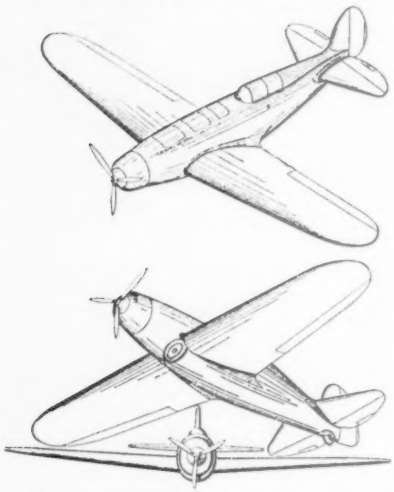
PARKS Air College, East St. Louis, Ill., not only operates a flying school but also conducts a full college course in aeronautical engineering that is proving of great interest. Their breezy and informative college paper, free for the asking, tells of the many activities of their students.

THE Brown Deer Airport, Milwaukee, Wis., is being reopened. This was originally the Holterhoff Flying Service base. There is space for six ships in the hangar, oil and gasoline will be carried and a repair shop will be operated in addition to instruction and passenger carrying service. Weather information for any part of the United States can be furnished on ten minutes notice.

Recent Patents in Aviation

A page of interesting aviation patents issued by the United States Patent Office. This information is supplied monthly by Rummler, Rummler and Woodworth, Patent Lawyers and Engineers, 7 S. Dearborn St., Chicago, Ill.

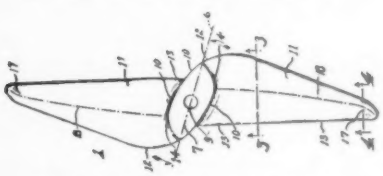
MAILPLANE DESIGN. No. 91,327.
Charles N. Monteith and Robert J. Minshall, Seattle, Wash., assignors to Boeing Airplane Company, Seattle, Wash., a corporation of Washington.
Term of patent 7 years. Issued Jan. 5, 1934.



The ornamental design for a low-wing monoplane for mail service as shown and described.

* * *

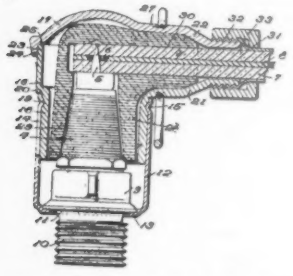
PROPELLER BLADE, No. 1,949,611.
Fred J. Martens and Clinton O. Thompson, Milwaukee, Wis., assignors of one-third to Edward A. Wilke and Mae V. Wilke, Milwaukee, Wis. Issued March 6, 1934. 2-claims.



The tip and the stem of the blade lie on either side of the propeller shaft center.

* * *

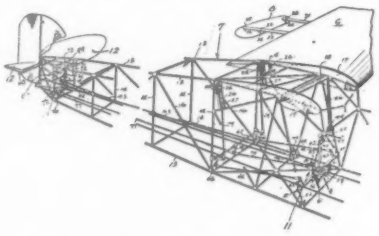
SPARK-PLUG, No. 1,943,739.
Edward B. Nowosielski, Bloomfield, N. J., assignor to Eclipse Aviation Corporation, East Orange, N. J. Issued January 16, 1934. 12-claims.



A shield for a spark-plug consisting of a cylindrical metal sleeve and having an upturned metal lip at the bottom which engages the flange of a spark-plug. A number of slits are located near the upper end and a metallic elbow with its cylindrical portion telescoping within the slitted portion of the sleeve are frictionally held in place. A boss projects at right angles to the cylindrical portion and an elbow of insulating material is placed within the metallic elbow to insulate the positive terminal and ignition cable of the spark-plug from the metallic parts of the sleeve.

* * *

AIRCRAFT, No. 1,945,520.
George Wilbur Cornelius, Glendale, Calif. Issued February 6, 1934. 10-claims.

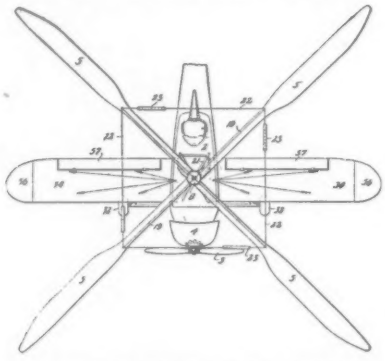


In this patent, the wings are supported by the fuselage so that they can turn about a lateral axis. At the trailing edge of each wing there is a connection for guiding the rotative movements of the wings within limits. An auxiliary wing is supported in spaced relation to the trailing edge of each wing so as to exert a righting movement on the wings by means of the air pressure on the auxiliary wings. An adjustment is provided for maintaining the auxiliary wing in a selected angular position.

There is a control mechanism in the fuselage connected to the main wings through the guide for manually controlling the angle of attack of the main wings.

* * *

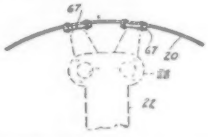
AIRCRAFT WITH ROTATIVE WINGS, No. 1,948,514.
Juan de la Cierva, Madrid, Spain, assignor to Autogiro Company of America, Philadelphia, Pa. Issued February 27, 1934. 32-claims.



The rotating sustaining blades of this aircraft are revolved by the flight airstream, the propelling screw being vertically offset with respect to the center of gravity of the aircraft, and at such an angle that the line of thrust passes approximately through the center of gravity.

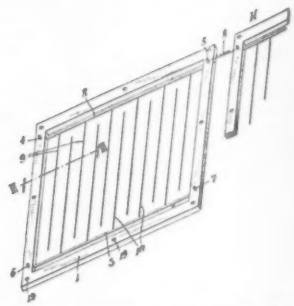
* * *

COWLING RINGS, No. 1,943,528.
Harold A. Hicks, Detroit, Mich., assignor to Ford Motor Company, Dearborn, Mich. Issued January 16, 1934. 20-claims.



This is a method of attaching cowl rings to a radial engine without rigidly connecting the ring to the engine. A series of pads on the inside of the ring engage projections carried by the cylinders.

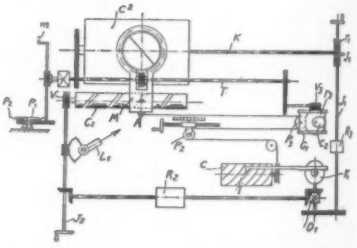
MEANS OF PREVENTING ICE, No. 1,943,062.
Edward A. Driscoll, New York N. Y. Issued January 9, 1934. 7-claims.



This device prevents the formation of ice on wings and similar aircraft surfaces. An absorbent cover is provided for the surfaces which carries electrical heating conductors of opposite polarity, spaced apart by the absorbent material. When this material becomes moist, current passes through the moisture and generates heat. This prevents the formation of ice.

* * *

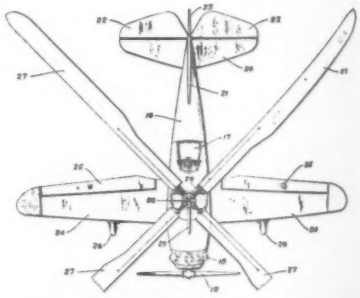
APPARATUS FOR DETERMINING THE COURSE AND SPEED OF AIRCRAFT, No. 1,943,397.
Rene Riberolles, Paris, France. Issued January 16, 1934. 8-claims.



An apparatus for determining the course and speed of an aircraft making a sight angle and azimuth angle in travel. The altitude of motion is known. The combination of a rotable tracing cylinder and a telescope adapted to be trained upon the aircraft and movable in azimuth with means for connecting the telescope and cylinder.

* * *

AIRCRAFT SUSTAINING ROTOR, No. 1,948,457.
Agnew E. Larsen, Huntington Valley, Pa., assignor to Autogiro Company of America, Philadelphia, Pa. Issued February 20, 1934. 25-claims.



The blades of this Autogiro rotor rotate about an approximately vertical axis. There is a blade joint providing for movement in addition to the rotary motion in the general path. The joint provides for pivotal movement.

Avigation

(*Continued from page 376*)

tinuously alert, the avigator's mind should be more like that of the "absent minded professor" in that he should have the ability to concentrate on one problem to the exclusion of others and in spite of the noise, motion and vibration of the plane.

The avigator is required to make relatively intricate mental calculations and then, by calm judgment, to base the course of the plane on the results of all the factors considered.

The qualifications of avigator and pilot are alike in that each should possess confidence, energy, and the ability to arrive at correct decisions without making costly mistakes. In some professions, mistaken judgment may later be corrected without serious embarrassment, but in the air a mistake by either the avigator or the pilot might be disastrous.

The ideal combination would of course be to have in one person the skilled pilot and the expert avigator. Unfortunately, we do not grow them that way. In the first place the full time of a good man may easily be put on piloting without knowing all that there is to be learned about it.

This is an age of specialists where jacks-of-all-trades have little chance to succeed. On the other hand, the nature of flying requires that each plane in flight have the combination of pilot and avigator. In single-seaters, one person is required both to direct and to fly the plane, but as any aviator will attest, a solo flyer on a long hop is as busy as the proverbial bird dog.

Under these circumstances we should make the best of the situation by matching a skilled pilot with a fair amount of avigation training with an expert navigator who is also a "ham" pilot. The pilot would normally take off, fly the plane, and make landings. The avigator would normally operate the radio and navigate the plane. In an emergency, the avigator would be the co-pilot, taking the controls in the air, or making emergency landings.

On the other hand, the skilled pilot should have the ability to do the avigation required in an emergency. In other words, we should have in each long distance plane, the chief pilot and co-avigator serving with a second person who is avigator and co-pilot.

During 1929, there were dozens of schools teaching air navigation, but the depression has reduced the number of these schools to perhaps less than twenty. In fact, there are very few advanced avigation schools for the private or commercial pilot. To date, the demand for such schools has not been large, yet with the approaching ocean scheduled flying and advanced course in avigation is greatly needed in the United States if we are to keep abreast of other countries in oceanic flying.

END.

MORE POWER • MORE SPEED
MYSTIFYING PERFORMANCE
MORE ROOM • MORE COMFORT
• STREAMLINED BEAUTY

THE 1934 WACO
CABIN PLANE

The 1934 WACO Cabin Plane is the result of the most advanced airplane engineering. It embodies all the features that made the 1933 WACO Cabin Plane the leader in its field—plus major refinements that add to the pleasure, comfort and enjoyable thrill of flying.

The cruising and top speeds have been increased, yet this new WACO Cabin Plane retains the mystifying ability to get in and out of small fields—tight places that would be shunned by other planes—typical WACO performance.

The fuselage is rounded and the fairing is more complete; including the lower wing, which adds beauty and gracefulness.

Controlled interior ventilation brings into the cabin warm, cool or tempered air—as much or as little as you want.

There is more leg room for passengers occupying the rear seat. And new, deep, auto type springs in the rear seat cushion and back give additional comfort. Good vision in all directions adds to the pleasure of flying in the 1934 WACO four-place Cabin Plane.

Three power plants are available—the Continental 210 H.P. radial—the Jacobs 222 H.P. radial and the Wright 7-cylinder, 250 H.P. radial. The Jacobs can be had either with the conventional dual Scintilla Magneto or with Bosch dual battery ignition, which includes a generator.

But let us send you complete information. Or, better still, why not arrange to take a flight with our local dealer? It will not obligate you in any way. If you do not know his name, write us.

THE WACO AIRCRAFT COMPANY, TROY, OHIO

WACO AIRPLANES

"Ask Any Pilot"

WACO LEADS IN AIRCRAFT REGISTRATIONS

Nungesser

(*Continued from page* 360)

ing from public places in the expensive sleek Rolls-Royce roadster which the Prince of Wales gave to the great Ace as a demonstration of esteem when he won his thirtieth victory.

But Nungesser was destined to spend more time in French hospitals than in cafes. To give you some idea of the enormous amount of suffering he endured and to more accurately appreciate the character and grit of this man who, like Rickenbacker, was older than the average pilot, I set an authentic list of his wounds: (1) fractured skull, (2) concussion of the brain, (3) jaw fractured five times from smashing into the instrument board (there was a visible scar on his chin), (4) numerous shell splinters in arm, (5) knee dislocated three times, (6) bullet in the mouth, (7) broken collar bone, (8) dislocated right ankle and (9) dislocation of left wrist.

Each time he got out of the hospital he came back for more punishment. After the French had retired him for his many wounds, he flew borrowed planes and downed nine more Germans. A man of iron!

Immediately after the first Spads' appearance at the Front, Nungesser again visited the Lafayette Escadrille. He flew a Spad with a 140 h.p. Hispano-Suiza and brought the heavy short-winged ship down to a swift landing. A new gadget he had installed was a three or four inch circular rear-vision automobile mirror clamped to a strut to the right of his cockpit. On his new ship he had painted a curious identification. It was a large heart on which appeared a coffin flanked with burning candles and, as if to make his artistic scorn of fate more complete, a grotesque skull and cross bones were painted beneath the coffin. The Iron Man laughed contemptuously in the face of Fate.

* * *

NUNGESSER won many brilliant air fights, but he chose to tell about his sixth victory which left a most poignant impression upon him.

"Which was my hardest fight?" Nungesser paused and his small eyes and square chin sobered. "I hardly know—among so many it is difficult to choose any single one as being outstanding. Was it on the day of my quadruple victory? Surely that was a day of thrills. Still, the day I set fire to a sausage squatting on the ground was a rather thrilling one. Or possibly it was when I had a triple victory on September 16th, 1916? Yet, when I think real hard about it, I believe that my sixth victory left the deepest impression on me.

"It was on April 27th, 1916. I was out on patrol and attacked a light squadron composed of three Fokkers and three L.V.G's. I first tackled the straggler of the group, the one who is lagging behind. It falls in flames into the Spincourt Woods. Then the others, instead of running away, surround me on all sides and try to knock me down.

"What a melee and racket that was. More than a thousand bullets are fired in my direction. Every one of them has my name on it, but the address must have been wrong.

"What to do? I grope for an answer. To flee! No, they would be only too glad and their target would be still easier to strike.

"Well then, what?

"I do not hesitate, but shuffle the cards and deal myself a joker. This is the way I do it. I rudder toward my aggressors, as if I wanted to inquire my way out. I get it point blank, then they tighten the grip around me.

"Yes, but I am able to fire and do not miss the chance. While they, silly asses, do not dare any longer to use their machine guns for fear of getting one another. And wearied out, they are indeed compelled to take French leave, like boars, sneaking away with their tusks to the ground.

"True it is, they have left with souvenirs. Twenty-eight bullets in my plane, seven bullets in the motor, five cylinders only of which are working. Controls are cut to pieces. One bullet hole through my helmet, another through my sock, my flying suit pierced in many places. In that condition I guide my wobbling plane over the lines at eight hundred meters amid an inferno of fire from the ground.

"But I swoop down and land safely, however, without breaking anything more, back of our own trenches.

"Yes, that must have been my most thrilling encounter!"

Among the medals awarded to Captain Charles Nungesser was the Medaille Militaire, Croix de Guerre with 23 palms, Legion of Honor, British Military Cross, Belgian Croix de Guerre and Order of Leopold, Italian Iron Cross, the United States Distinguished Service Cross, and many others.

* * *

DO you know that in the United States there is a Nieuport which was flown by Charles Nungesser? Yes, I have seen it and you may, too, if you happen to drop in the Roosevelt Field Historical Museum. And there you might also see George Pickenpack, who did a lot of flying with Nungesser. I asked K. S. Lindsay, Operations Manager of the field, to tell about Nungesser's ship and his visit to this country. Mr. Lindsay said:

"Through communication with the United States military attache in Paris, France, we have learned that in 1924, Captain Charles Nungesser and two French pilots brought a Nieuport 18, a Potez and a Hanriot, all French airplanes, to this country. They made a barnstorming tour, putting on stunting exhibitions at county fairs, air meets and large gatherings. Of these three machines brought over, the Nieuport which is now in our museum, is the only one left in the country to the best of our knowledge. We have made attempts to locate the other machines without any success.

"While making these barnstorming tours, Captain Nungesser conceived the idea of making an aviation movie thriller. This picture, taken on Roosevelt Field about 1925, was called the 'Sky Raider' and was, I believe, the first real aviation movie thriller ever filmed in this country. Three pilots still flying on Roosevelt Field took an active part in that picture and remember Captain Nungesser very well. One of these pilots, George Pickenpack, is today one of the Roosevelt Field Corporation staff pilots.

"I am told that, shortly after the picture was made, Captain Nungesser had some financial reverses and lost these three machines. The Nieuport turned up later in a New York warehouse and was purchased by Mr. Russell Simpson, now head of the Aero Brokerage Service here on the field. The original engine, a 130-horsepower Clerget rotary engine, was removed by Mr. Simpson and a eighty-horsepower Le Rhone engine was installed in its place. The machine was flown here for a few years and then disappeared.

"Old airplanes, being large and bulky, are rarely found on airports today. In nearly every instance, we have located them stored away in barns and hay lofts, often in towns not even having an airport and, strange to say, most old planes are found by aviation model people who write and tell us about them.

"I spent several months tracing Nungesser's Nieuport and at last located it stored away in a hay loft up in Florida, N. Y. It was subsequently purchased and brought back to Roosevelt Field, where it was restored to its original appearance and condition."

After the above episode of a World War Ace's life, Nungesser returned to Paris. On May 8, 1927, as you may recall, he and Major Francois Coli set out from Paris in a well-equipped plane, to beat Lindbergh across the Atlantic and to make the first east-to-west crossing of the ocean. Their destination was New York City. Fourteen hours flying time from France they were somewhere off the coast of Ireland and headed their "White Bird," which bore on its fuselage Nungesser's gruesome jest—the coffin, skull and cross bones—into the worst weather conditions imaginable. Nothing was heard from them from this point.

Because of their equipment and skill as aviators, it was always assumed they had gone far over the Atlantic, or even reached North American shores, because otherwise they would have turned back in case of serious trouble. Reports that their motor was heard over Newfoundland were for six years unverified.

And so, this victor of many a battle, was downed to his death by Father Neptune in peace-time adventure.

END

All photographs are of C-D models

ALREADY OVER HALF

1932 BOEING P26
Superdetailed. Span 21¼", length 17⅞", weight 2.5 oz. Yellow and olive drab. Printed out wood. Complete Kit SF-23, only **$1.75**

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Far easier to build than our other G. L. S. Trainers. Capable of excellent flights due to lower center of gravity, with heavier balloon wheels and dihedral in both wings and increased size of all tail surfaces. Includes Cleveland's newest features. Span 20", length 15⅛", weight 2.1 oz. Colored orange and black. Printed out wood. Block for pilots. Complete Kit SF-1G, postfree, only **$1.75**

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Believed far more accurate than any Spad yet modeled. Almost suitable for a wind tunnel test, so precise are measurements and fittings. Span 19¼", length 15⅝", weight 2.5 oz. A beauty in looks, and a good performer. Colored yellow and green. Printed out wood. Blocks for scale propeller and pilot. Complete Kit SF-13B, postfree, only **$1.75**

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¾" scale of one of the new 2-place Corsairs. Like the Curtiss Helldiver, altho more stable flying on gusty days. Super detailed. Embodies many new Cleveland features. Span 27", length 19½", weight 4.2 oz. Colored blue, yellow, red, black and silver (7 bottles liquids alone). Printed out wood; blocks for pilots. Complete Kit SF-41, postfree, only..... **$2.95**

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A model brimful of realism and performability. Detailed to the last feature—machine guns, windows, gas tank, wing flaps, dummy motor incidentals, venturi, and pilot tubes, etc., etc. All balsa wood is printed out and numbered. Span 33", length 24", weight 4.7 oz. Army yellow and olive drab. Complete Kit SF-25..... **$2.75**

'32 Berliner-Joyce P-16
¾" scale. Two Seater pursuit. Span 35⅛", length 21", weight 3.9 oz. Yellow and olive drab. Complete Kit SF-39, only.. **$3.00**

All pictures here are of the actual Cleveland-Designed models themselves — we never use pictures of the big planes to advertise C-D models.

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The dream of the lightplane lover. Keen looks; keen flights; Span 27", length 15¼", weight 1.9 oz. Red and silver. Printed out wood. Block for pilot. Complete Kit SF-40, only **$1.75**

1933 CURTISS F9C-2
Superdetailed. Span 19⅛", length 15¼", weight 2.2 oz. Silver, blue, red and black. Printed out wood; block for pilot. Complete Kit SF-22B, only **$1.75**

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Combination Kits—2 in 1!

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This well known cream-and-orange sky beauty, is more authentically duplicated for a flying model than any built heretofore. Span is 25", length 15⅝", weight 2.2 ozs. Kit includes sufficient material to build also the JSF-2 Glider. Complete Kit SF-28, only..... **$1.50**

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Fairly simple to build and flies beautifully. ¾" scale. Span 23⅜", length 12¾", weight 0.8 oz. Colored silver. Kit also includes all materials for building the Primary Training Glider. Complete Kit SF-26, only..... **$1.25**

Over $8.00 value in drawings alone!

In Issue No. 7 of CLEVELAND MODELMAKING NEWS and Practical Hobbies

Large sheets—17" x 44"—full size ¾" scale drawings of the superdetailed, much talked about VOUGHT CORSAIR V65; ⅜" Lindbergh's Lockheed Sirius; 1/16" sensational new Union Pacific Streamland Train; ¾" high speed Packard Phaeton (one of the swankiest cars Packard ever built); ¾" India Elephant—a project that has stirred up interest of museums all over the country for its remarkable realism—AND THIS ISN'T ALL! Dozens of smaller projects, in 1", ⅝", 1/16", ⅛" and 1/16" scale—world war machine guns, airplanes, pilots' heads, modern hangar, residence and landscape, 2-oar racing shell, Civil War field gun. This, WE KNOW, is the greatest assortment of authentic model projects—painstakingly detailed and reproduced—ever offered to model builders at such an amazingly low price. Any single one of the large drawings, if sold separately, would be priced at much more than the small 40c price set on this model textbook in magazine form. Copies are going fast—without qualification, it's the finest issue we've ever published, in looks, material and size—don't delay sending for yours. Send either 40c (no stamps) or $1.50 subscription to cover Issues No. 7 to 10 inclusive. Issues No. 1 to 6—still available at 25c each. No. 3 sold only when all six issues are ordered. **FOREIGN CUSTOMERS: Add 5c extra per issue to all above prices.**

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Gasoline

(*Continued from page* 362)

ties themselves have been improved greatly in the last few years and are now models of efficiency and safety.

Taking all factors into consideration, the gasoline portion of the total cost of operating an airplane cannot be considered excessive, even though aviation is made a victim of the peculiar work of politics, queer thinking, or what have you, which requires that aviation gasoline pay the gasoline tax, revenue from which goes mainly to the construction and maintenance of highways, which aviation directly does not use.

Here is a table based on the experience of some oil companies with reference to average costs of gasoline for operating airplanes of various size and power, in all parts of the country. It is not intended to be conclusive, but gives a fair, general idea of what the situation is:

FUEL COSTS FOR FLYING

Rated Horsepower	Gasoline Cost Per Hour of Flying
400	$4.20
300	3.80
250	2.85
210	2.40
160	1.90
125	1.50
110	1.45
100	1.30
90	1.20

It might be interjected at this point in explanation of the above figures on gasoline consumption that they are for application to radial air-cooled engines such as are in common use. It probably should be stated also that these costs are not intended to give an idea as to the highest cost which might be encountered. Under certain conditions the costs might mount to considerably higher levels.

If the above per-hour gasoline flying costs be analyzed and broken down—somewhat arbitrarily, it must be admitted that the per-mile cost of gasoline is certainly not out of the way when compared with results obtained in the motor car on the highway. For instance, take a popular make of motor car in which a rated horsepower of approximately 90 is claimed. It is asserted this car will produce a gasoline consumption of about 15 miles per gallon. At around 18 cents per gallon, this is not far out of the way when compared with the 90 horsepower airplane carried in the above table. Of course, all these figures and deductions, it must be emphasized again, are highly theoretical and are easily affected by variables of operating conditions. Nevertheless, they should permit a good general idea of conditions.

Today's fuel for airplanes must be not only a high-gravity, high-volatile product, clean burning, virtually free from sulphur, free from any important amount of sediment, and permitting no gas-lock nor undesirable conditions, but it must also be a product strongly resistant to the tendency to detonate or "knock," the same element which is giving automotive and oil industry engineers worry in motor cars. The matter of weight is important. The gasoline must furnish maximum power at the lowest actual weight of the product which it is practicable to secure.

Oil companies have been able to develop suitable motor fuels for aviation by virtue of several factors, not the least of which is the fact that the oil companies have done their research and development work not only in the technical surroundings of a laboratory, but in actual service in the air. Oil companies have many planes of their own in operation. Some of these have undergone gruelling tests on all kinds of fuel from extremely low grade—much lower than it would be thought possible could operate a plane—up to extremely high grade materials. The gasolines now in use constitute a sort of "golden mean" between the extremes.

There have been great handicaps placed in the way of intelligent and scientific development of suitable distribution of motor fuel for aviation. In by far the largest portion of cases, the consumption of gasoline from airports is far below the point which makes it commercially feasible to handle the product. In some such cases, no gasoline is for sale there. In others—many others—gasoline is supplied and handled at a distinct loss.

Oil companies—mostly the larger ones—are planning their modes of operation in supplying gasoline to withstand the even more exacting requirements of the future. High pressures and high temperatures in the combustion chambers place a strain of extreme responsibility on motor fuel but most of the material now being sold and used is meeting the responsibility in good shape.

Aviation gasoline is more than a simple automobile fuel. It must vaporize freely in cold weather flying. It must withstand high compression pressure without decomposing, detonating or burning the valve seats. It must have a sufficient percentage of the "heavy ends" to insure stability and yet they must not be present in excess. The "light ends" must be within limits to avoid excessive loss by vaporization and to avoid an undue fire hazard. All these are conflicting factors among themselves calling for skilled adjustment.

Right now, more and more attention seems to be given to stepping up and keeping up the "octane number" of the gasoline, as a measure of the knock-resistance of the product. Octane number of highest grade tetra-ethyl leaded gasoline for motor cars will run somewhere around 80. Currently, there is a keen rivalry between the Ethyl Gasoline Corporation and the interests favoring the use of refining and cracking processes alone, without addition of other materials, for advantage. At the moment, the advantage appears to be with Ethyl.

END.

Forgotten Birdman

(*Continued from page* 368)

while its traffic laws became jokes. They mention the strange scarcity of patrolmen on the highways in any except the finest weather and mention also the fact that well-fed patrolmen seem to have a powerful magnetic attraction for hot-dog stands.

Rumors are going around that there must be a reason for all this sudden activity in the aviation line—some are even hinting that there must be something in it for somebody.

Others are making even more potent comment. Right now, in the midst of the Army mail crashes, is a mighty poor time to start anything like this, so they say. Everybody knows that the Department of Commerce flying tests are based upon those used by the Army.

The Army's tests, being the more stringent, should certainly pick out the natural-born, crash-proof flyers and ships, if the government's fancy theories about visual acuity and blood-pressure are correct. But, say the boys, it begins to look like nobody is crash-proof in this game, not even Uncle Sam's handpicked and admittedly foursquare Army boys. So, the forgotten airmen are saying—"why ride our necks?"

The boys are fluttering around like a bunch of lost birds—from now on they'll have to do *all* their fluttering on the ground if they lose this battle.

Protests to Governor Clarence D. Martin have brought polite replies from the governor's secretary, and nothing more. The state legislature is not in session this year, so nothing can be done in that direction. The only way out seems to be an initiative petition or a test case.

Otto Vieweg—pilot, glider and airplane builder, amateur flying enthusiast—has formed a group and has opened a campaign for "repeal or modification" of the state's law. Vieweg asks all interested amateur flyers in the state to get in touch with him.

END.

Aero-Sportswomen

(*Continued from page* 382)

WNAA, etc., to be of any service that we can.

When Amelia Earhart, who is one of the organizers and past-president of the Ninety-Nines, was in the city recently, the new chapter of the organization and the Women's National Aeronautical Association were invited to a tea given in her honor by Marshall Field & Co.

Since most of the Chicago 99's are members of the WNAA also, the two groups are closely affiliated, which we feel is an ideal situation. As Phoebe Omlie said: "Cooperation is the one great need of our industry and the sooner we realize it, the better all of us will be."

END.

Stinson Reliant

(*Continued from page* 371)

Particular attention has been paid to the comfort of the pilot. An arm rest has been provided and both pilot seats are adjustable. The indirectly lighted instrument board has been redesigned with the instruments mounted in rubber so that they are easier to read while in flight and are protected against vibration. The control column, of the dual type, is adjustable fore-and-aft and one control wheel is easily removable.

Airline practice has been followed for the comfort of the passengers. Noise has been very greatly reduced by scientific methods and a transport type heating and ventilating system has been so designed that it permits the passengers to regulate the amount of fresh warm or cool air entering the cabin, also enabling them to regulate the temperature to their needs. All passenger windows may be raised or lowered with automobile type window regulators.

The floor is carpeted and among the minor refinements are divan type seats, map pockets, rear cabin side-lights, ash receivers, glove box, vanity closure and assist cords similar to those used in automobiles.

Every attention has been paid to the interior arrangements and finish. The instrument panel and metal window mouldings are finished in colored lacquers. Taupe side walls are furnished with the divan seat backs in optional colors. The dual control column is finished in two-toned chromium and lacquer finish.

A large baggage compartment provides sufficient room for holding bags and golf clubs. It is accessible from both the inside and the outside of the cabin. When the outer door is opened, a light is turned on automatically which is a great convenience at night.

In its external appearance, the 1934 Reliant is everything that can be desired. It is given a high luster 12-coat finish which is suitably striped and decorated. This finish is not only attractive but it is an insurance against the effects of the weather as well.

For thorough and rapid inspection, access to the chomemoly fuselage structure, the wing ribs, ailerons, control system and brake system through inspection doors provided with "zipper" fastenings.

The wing ribs are of metal, while "I" beam steel compression struts are used. The drag-rods are of chrome-nickel steel of the highest grade.

END.

INVENTORS

Time counts in applying for patents. Don't risk delay in protecting your ideas. Send sketch or model for instructions or write for FREE book, "How to Obtain a Patent" and "Record of Invention" form. No charge for information on how to proceed. Communications strictly confidential. Prompt, careful, efficient service.

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ANNOUNCEMENT

We wish to announce that Model-Aire-Craft (formerly Mueller Bros.) is now in a position to build and sell completely finished models. Wingspreads range from 3" to 7". Our special this month is the Boeing F4B-4, with a 5½" wingspread, lacquered in Navy colors with all insignias and rigging for only $1.00 postpaid. Actual photo of this model for 5 cents. Any other model can be had for $1.25 postpaid. Every model is built under the personal supervision of Albert Mueller, who placed fourth in the P. A. International contest. No C.O.D. orders. Canadian and Foreign 30% extra.

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LOCKHEED VEGA

Span 20¼" Length 13¾" ¼" Scale

Just look at it—A flying model with all the smartness of the real plane. Note the trim lines and authentic details. You'll get the thrill of your life when you put the finishing touches on this clever ship. It's there—no other word for it.

PEERLESS printed wood makes cowl, motor front, wheel pants, etc., easy to build. Wheels are specially turned from hard wood and add just enough weight to the nose to make it a great flyer. Colored PEERLESS orange, striped in black with scale prop and inside of cabin in silver.

And with the completely detailed PEERLESS plans you can build this model quickly and easily. You can't go wrong if you just follow the plans.

Hurry and build one of these sturdy models now. Summer and good flying weather are waiting for you.

Complete kit, printed balsa, plans, insignia, cement, etc., shipped express prepaid. Add 15c shipping charges..... $1.45

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Send 3c stamp for illustrated folder of Peerless Kits and Supplies. You will be agreeably surprised at our complete stock of supplies and accessories. Your dealer can get Peerless Kits and Supplies for you if he does not now handle them.

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PEERLESS MODEL AIRPLANE CO.
15535 Madison Ave.,
Lakewood, Ohio
(Member NRA)

Airy Chat

(*Continued from page* 354)

public to the wholly disgusting acts of politicians in reducing the efficiency of our national defense.

* * *

WE are accused of spreading propaganda favorable to the entry of the automobile industry into the domain of aeronautics. Nothing can be farther from the truth, but unfortunately, the fact remains that the automobile people are steadily gaining a foothold in aviation whether we like it or not. They have not asked our permission. One has only to read the Patent Office Gazette monthly, to note the number of valuable airplane patents that are being assigned to automobile manufacturers and to the manufacturers of automobile supplies and accessories. These people do not buy patents for fun.

Specifically we can mention the General Motors Corporation which already has large holdings in aviation and which, according to the annual statement to stockholders, intends to continue along this line. Then we have the Cord interests which now own or control the Stinson Airplane, Lycoming motors and the Smith Propeller. Ford and Packard have always been inclined in that direction. Continental Motors have been building aviation engines for a long time, while the Borg-Warner corporation have recently been reported as the latest entrant of auto accessories to enter into aviation engine development. And there are others.

* * *

THIS calls to mind the celebrated $700 airplane that was set into motion by the U. S. Department of Commerce. To our mind, this is just one more temptation for the automobile industry to get into aviation.

Unfortunately, this sort of thing is right down their alley, and should they once gain the upper hand in mass production of cheap planes it will be difficult to stop them. This is just one more weak spot in our armor created by a doubtful policy of the Dept. of Com. We must look the facts in the face and not live in a fool's paradise.

Automobile manufacturers are tough opponents. They understand mass production. They have almost unlimited funds for development purposes. They have nation-wide sales and service organizations that could handle planes as well as cars.

* * *

NOT having heard from the $700 air-flivver for a long time, and hearing rumors that the project had been abandoned, we sent a telegram to the Dep. of Com. to find out just how this matter stood. And this is the telegraphic reply that we received:

"RETEL RUMORS THAT GOVERNMENT HAS DROPPED NEGOTIATIONS FOR VOLUME PRODUCTION LOW PRICED AIRPLANE ABSOLUTELY UNTRUE STOP WE HAVE BEEN DELAYED IN THIS PROGRAM BY AIRMAIL SITUATION AND HAVE NOT RECEIVED ALLOTMENT PROMISED BY PWA BUT WILL PROCEED VIGOROUSLY AS SOON AS CURRENT AERONAUTICAL CONDITION CLARIFIED STOP THANKS FOR YOUR INQUIRY"—EUGENE L. VIDAL DIRECTOR OF AERONAUTICS

And, you rumorers, that is straight from headquarters and is the official dope. For one, I'm going to start saving my pennies right away, so as to be one of the first to take off in the less-than-one-thousand-dollar class. Thank you, Mr. Vidal—best wishes, for an early start.

* * *

AND here is another telegram. We sent a copy of the Hawker Super-Fury drawing, that appears on the cover of this issue, to the builders to make sure that everything was O. K. And they cabled right back from Kingston-on-Thames:

DETAIL OF FURY PICTURE SATISFACTORY. HAWKER.

So now, you cover critics can rest assured that the ship shown on the front cover is O. K. so far as the builders are concerned, but, I am willing to bet that some guy way down in the Antipodes (meaning the sticks) is going to point out some grievous error, just the same.

* * *

DINKY composition is now at its full height. Not being able to print all of the dinkys without adding 32 pages to this issue, we closed our eyes and picked out a few of them at random. No. 1 is singled out from a collection of heart-throbs by Richard Lund, 62 Maple St., Auburndale, Mass. No. 2 is by that renowned dinky addict, M. Walter Monk, 60 N. Main St., Glassboro, N. J. Away we go.

NO. 1	NO. 2
Lightplane	Just started,
grounded,	Ocean hop,
Rots in shed,	Sure hope
Ambitious owner,	It's nonstop.
Has sorehead.	

We hope so, too, Mr. Monk. But this prospect does not discourage him for he's right back with—

NO. 3	NO. 4
Douglas picture	Got license,
Sure neat,	Some fun.
Have more,	Great time,
They're a treat.	Just begun.

Wallace Swanson, R-5, Box 145, Minneapolis, Minn., threatens to send some more dinkys if No. 5 is accepted. The author of No. 6 liked the back-page picture of the Wedell-Williams racer, and just as a little mark of his appreciation, dedicates sonnet No. 6 to the cause. His name is Craig Stewart and he lives at 5 Germain St., Worcester, Mass.

NO. 5	NO. 6
Stick back,	Man in rain,
Nose up.	Heavy hail.
Hold'er back,	Poor old plane,
Climb up.	Now "for sale."

Annyhoo, this is a great and agreeable change from the previous obituary type of dinky that used to come in. Glad we're getting away from crash stuff.

* * *

WE always welcome a letter like the following, from the boys who were "over there." This letter is from Philip R. Babcock, 11 Tedesco St., Marblehead, Mass.

"I was particularly interested in the article appearing in January POPULAR AVIATION by Carl B. Ogilvie, entitled 'Eight Yanks Won the Same Cross.'

"There are but three of us left now, of the eight who took part in the August 11, 1918, battle. Lieut. Bernheimer died since the war.

"Ogilvie has certainly written it up in fine style and I am still passing the word along to former 88th Squadron pilots to secure a copy."

* * *

WHO do you think paid us the honor of a visit the other day? No one else but Stanley Rowan, the indomitable bedroom airplane constructor—You remember the story that we printed about him sometime ago? Well, Stan has been having a lot of fun and some thrills with this little ship, which by the way, was entered in last year's races held in Chicago. And, he came in for place in this race, believe it or not, but his modesty prohibited him from giving himself credit for this achievement. "It wasn't because I was so good," quoth Stan at the interview, "but that the other guy was poor." That's the acme of sportsmanship, I'm telling you!

He had a great thrill, not long ago, when coming in from a cross-country flight. He overestimated the amount of gas in the tanks, and when directly over the city of Chicago, she started p-p-p-popping and was just ready to conk out when, by good fortune, he just made the boundaries of a golf course by a fraction of a foot. Yeh, it may be just as far from Indianapolis to Chicago, geographically, as it is from Chicago to Indianapolis, but not always so by air, as Stan discovered on his return trip against a prevailing west wind.

* * *

WE are very greatly interested in knowing what the general reaction is to the present cover arrangement, and it will be as much to your advantage as to ours if you will write and tells us what you prefer. Would you rather have the usual full back page photograph or the new colored drawings on the back page? We can't have both, as you can easily understand. Again, would you prefer the present type of color drawing on the front cover to a new colored and authentic photograph on the front cover? It's up to you fellows for we don't care.

* * *

Seems as if we get down to the end of this department before we get fairly started. Well, see you next month.

J. B. R.

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Engine Quiz

(*Continued from page 382*)

of the engine as determined by a dynamometer or brake.

Q. What is peak horsepower?

A. The greatest amount of power that an engine is capable of developing.

Q. Does the power increase with the speed of the engine?

A. Yes, within limits. The power increases in almost direct proportion to the speed up to a certain point, and then starts to fall off when this speed is exceeded.

Q. What speeds are generally used with aviation engines?

A. The maximum speeds at which peak horsepower is obtained will range from 1,400 to 3,000 revolutions per minute (r.p.m.). The majority run close to 2,000 r.p.m. at peak output.

Q. Can the engines be run faster than this?

A. Yes, but this is not desirable for the reason that the speed is limited by the propeller efficiency. High speed propellers are not very efficient when the engine speed greatly exceeds 2,000 r.p.m.

Q. What is meant by piston velocity?

A. This is the average speed that the piston would travel along a straight line in feet per minute. This will vary from 1,000 to 2,000 feet per minute.

Q. Is there a relation between the length of the piston stroke and the revolutions per minute?

A. Yes. In order to maintain a certain piston speed, the product of twice the stroke by the r.p.m. must equal this speed. Therefore, if the stroke is short, the r.p.m. must be increased. Short stroke motorcycle engines run at very much higher rotative speeds (r.p.m.) than the longer stroke large aviation engines.

Q. Does high speed affect the wear or life of the engine?

A. Yes. The higher the piston speed, the more rapid the wear, all other things being equal. The wear is very much greater at peak speed than at the lower cruising speed.

Q. What is meant by the term "engine torque"?

A. Torque is the turning or twisting effort exerted by the engine. It is comparable to the turning effort produced by turning a crank.

Q. How is torque defined, that is, how is it measured?

A. It is given in terms of foot-pounds or inch-pounds, generally the former. Thus, a force of 100 pounds applied at the end of a 6 inch crank will produce: 6 x 100 =600 inch-pounds or 50 foot-pounds twisting moment.

Q. How does this torque affect the engine and the plane?

A. The piston tends to turn the crankshaft in one direction, while the reaction of the pressure on the cylinder head tends to turn the engine and the plane (to which it is attached) in the opposite direction. The torque on the crankshaft and the counter-torque of the engine are equal but opposite in direction.

Q. Does the torque increase with the horsepower and speed?

A. The torque increases with the horsepower at constant speed but decreases with an increased speed. The torque becomes a minimum at top speed with a given horsepower.

Q. Is there a rule for computing the torque?

A. Yes. The torque (T) is in inch-pounds, the horsepower is (H) and the revolutions per minute are indicated by (N). Then:

$$T = \frac{63025 \times H}{N} = \text{inch-pounds.}$$

To get foot-pounds, divide the above result by 12. It will be seen, that when (N) becomes greater that the torque decreases with the same power.

Q. How is the torque determined for a given engine?

A. It can be determined directly by some dynamometers but it can also be computed from the known horsepower and r.p.m. as above.

WORKING PRESSURES—TEMPERATURES

Q. What is the maximum pressure produced by the combustion?

A. This depends upon many things, the condition of the mixture, the compression, the cooling system, etc. It can be approximated by multiplying the compression pressure by 3.0, but this is open to criticism.

Q. Then, if the compression is 100 pounds per square inch, the maximum combustion pressure will be about 300 pounds per square inch?

A. Yes — in that neighborhood. However, if there are detonations, the pressure will be greatly in excess of this figure. With abnormal head and piston cooling, with inefficient ignition or poor mixtures, it will be lower.

Q. How does a poor mixture reduce the maximum or peak pressure?

A. By delaying the combustion to such an extent that part of the fuel continues to burn while the piston is still moving out on the working stroke. To gain a maximum power, the fuel should burn instantly before the piston moves. Retarded or delayed ignition will have the same effect.

When the burning is prolonged, a greater part of the heat is rejected to the atmosphere and is lost when the exhaust valve opens. With a very poor mixture and adjustment, the loss through the exhaust may be as high as 60 percent.

END

Kid Glove Kid

(*Continued from page 376*)

way to get this guy down to their size.

You'd think they were planning an endurance flight for all the careful preparations they made. Pop, who usually is quiet and talks little, started the "build-up" and even invited the kid-glove pilot up to his house. We all were calling him that then.

Well, in about a week, Tex let us in on the dope and we all had to admit it was a smooth job. Tex used his Waco 10, which was his pet. Every nut and flying wire had to be just so. Guess Tex spent so much time keeping his ship right up to snuff that he didn't have time to "dress up" as he called it.

Well, anyway, under the cowling, he had rigged up a gallon can of oil. Had a tube running back to the rear cockpit and had hammered the end of the tube fan shaped. You wouldn't notice the tube if it weren't pointed out to you. From the top of the cowling he had another tube, rigged like the one just mentioned. You see, Tex wanted to make sure he didn't miss.

Believe me, they had it all figured out. As soon as the motor got real warm it would heat the oil in the can and the expansion would take place, forcing the oil out both tubes. As it was an open job, they figured as soon as our kid glove pilot stuck his head over the side a shower of oil would spray his shirt, tie and face, while the tube in the cockpit would fix up the spats. It certainly looked bad and all I could see that Tex was to get out of it was either a bust in the nose or a bill for a new suit.

With Pop's build-up, it was a cinch to get the kid glove pilot to fly Tex's ship. Pop had some story about the ship not doing a right snap roll and asked him to try it. They pushed the "10" out on the line and I was all set to call out the sheriff, when I saw him climb into the old ship in a light grey suit, blue shirt and tie, not even putting on a helmet. I had visions of all that black oil (leave it to Tex to put lamp black in the oil) "gooed" in those blonde locks.

Well, he poured the coal to the old ship and pulled off the field in a sweet climbing turn. Tex and Pop were pounding each other like a couple of Indians and howling and yelling. They figured it would take about fifteen minutes for the oil to spout and by that time he would be high enough so that he would be plenty "oiled" before he could get down again.

We watched him circle the field and it seemed to us he had over three thousand feet before he eased down the nose of the ship and then pulled it over in a loop. Then down again and up over into a peachy Immelman turn. It was a cinch that boy could fly. After that he seemed to fly straight for a while and then he pulled a snappy roll to the left and one to the right. I had visions of the kid being covered with oil and mad as a hornet when he landed.

He set the ship down on the far side of the field and taxied the ship up to the line. I thought Tex's jaw would hang on his knee cap when the kid stepped out of the *front* cockpit! It seemed the kid could fly better from the front seat and decided to change cockpits while he was in the air! You should have seen that rear "pit." Just smeared with oil. Of course he was wise by then, but only grinned.

The next morning when he came out to the field Pop and Tex were standing in the office. The kid said good morning all around when Tex grabbed his hand and said "Kid—you're OK" and then handed him a box. What the hell do you think was in that box? Two pairs of Six Dollar kid gloves!

END

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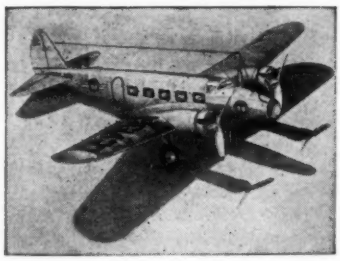

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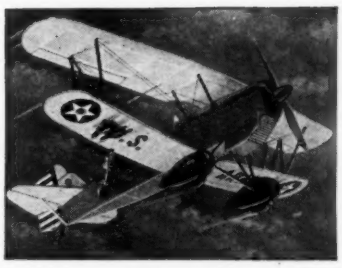

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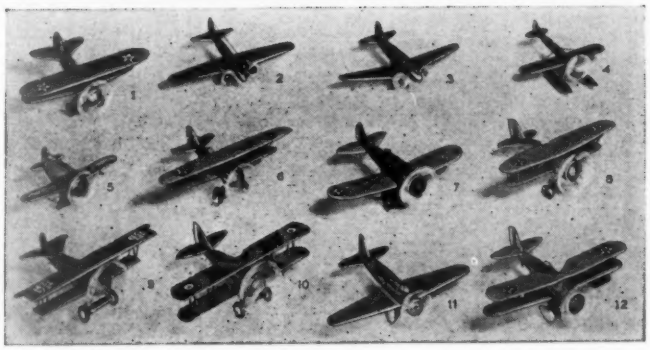

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Army Air Corps

(*Continued from page* 366)

month. Reserve officers may fly only 25 hours a year. On March 8, 1934, amendments to the bill for army appropriations were introduced by three air-minded members of the House, to increase the flying time of our army pilots to 20 hours and 50 minutes a month. The House *refused* to increase the time.

It is significant to note that, as an example of the strangling and starving practices of Congress and the General Staff, the Air Corps is the only branch of the army which is under-officered. Here are a few comparisons:

Branch	Allotment	In service
Infantry	3,314	3,757
Coast Artillery	945	1,047
Cavalry	750	945
Air Corps	1,650	1,282

In addition, the most obsolete and useless branch of the army, the cavalry, has 14 generals while the Air Corps has one.

The weed-entangled generals of the Regular Army miss no opportunity to wrap red tape around the Air Corps and to officiously assert their superiority of command. The United States is divided into nine military districts, designated "Corps Areas." Each is under the command of a *land* general. Before an army plane can fly from one Corps Area to another, permission must be secured from the generals commanding them.

The specifications of planes on which bids are to be let for their construction, must all go through G.H.Q. of the General Staff for an O.K. The Air Corps Chief specified that he wanted a pursuit plane with at least a 230 m.p.h. speed, 500 mile range and 27,800 foot service ceiling. General Pratt, another *land general* on the General Staff, changed these specifications to 176 m.p.h. speed, 386 mile range and 18,700 foot service ceiling.

The requests for the bids, bearing the changed specifications, were then mailed out and the Chief of the Air Corps learned of the change only after he had received a copy at the same time as did the bidders. It made little difference—he could say nothing about it anyway.

The inexcusable conduct of men in Congress, in the Army, and influential private individuals as well, has resulted in the virtual prostration of our Air Corps. Among the nations of the world, we are puny and weak, unable to defend ourselves in the air. How important is this? The Hon. John J. McSwain recently stated on the floor of the House of Representatives: "I know we must have an army and a navy, but if we have sufficient strength in air power, we may never actually have to use the navy or the ground army. . . . . Under modern scientific conditions it is manifest that the most powerful factor in any future war, and especially in its earlier stages, will be air power. With sufficient strength in the air we can prevent the landing of troops seeking to invade our shores."

Have we sufficient strength in the air? We most obviously have not, at this of all times, when the rest of the world is seething with the foreshadows of a coming war into which we may be drawn. The structure of our air power is weakened and emaciated by its division as branches under other departments—the Army, Navy, Post Office Department, Coast Guard, Forest-fire Service, Commerce Department and the National Advisory Committee for Aeronautics—instead of being a separate force under a Secretary of Air.

In this way, and this way only, can we have an efficient air force unhampered by prejudice, ignorance and stupidity of dusty land generals, barnacle covered and water-logged admirals and unscrupulous private individuals who prefer the present set-up for their own profit and who lobby in Congress to that end. In this way only can we overcome the needless expenditures of the duplication of effort and service that now prevails under the various departments. Great Britain, France and Italy woke up to this fact during the World War and acted at once in unifying their air services.

Look at the Mackenzie-Kennedy

TABLE IV

COMPARISON NO. 2
Foreign Army Fighters Attacking U. S. Army Airplanes
GROUP A: FOREIGN ARMY FIGHTERS—SINGLE-PLACE AND MULTIPLACE

Country	Type of Warplane	Max. Speed in m.p.h. at 15,000 ft.	Crew	No. of guns	War-Service ceiling in feet	Remarks
Great Britain	Vickers "Jockey"	238	1	2	36,000	
	Hawker "Super-Fury"	250	1	2	35,000	Vertical power dive 400 m.p.h.
	Fairey "Firefly II"	225	1	2	35,900	
	Bristol "Bulldog III A"	200	1	2	33,000	
	Gloster S.S. 19	207	1	6	32,000	Compare with "Shrike"
	Gloster "Gauntlet"	216	1	2	33,000	
	Hawker "Demon"	210	2	3	32,000	
	Fairey "Fox II"	210	2	3	32,000	
France	Dewoitine 500	230	1	2	35,000	207 m.p.h. at 26,000 ft.
	Nieuport-Delage 121C-1	229	1	2	39,600	Highest W-S. ceiling
	Loire 43C-1	221	1	2	35,000	
	Mureaux 170C-1	220	1	2	33,000	
	Breguet 41 M 3	195	3	5	31,350	Two engines
Poland	P.Z.L.P.XI.	215	1	2	33,000	
Italy	Fiat C.R. 30	214	1	2	30,000	
Japan	Kawasaki 92 (K.D. 5)	205	1	2	32,000	Licensed to build Hawker.
	Junkers K-47	190	3	3	33,000	Nieuport-Delage and Junkers
Switzerland	Dornier Do. C. 4	190	2	4	31,150	

GROUP B: U. S. ARMY FIGHTERS—SINGLE-PLACE
(Outclassed in speed and ceiling by foreign army planes in Group A.)

U. S. A.	Boeing P. 26	195	1	2	30,000	
	Curtiss "Swift" XP-934	192	1	2	30,000	

GROUP C: U. S. ARMY FIGHTERS—MULTIPLACE
(Outclassed in speed and ceiling by foreign army planes in Group A.)

U. S. A.	Berliner-Joyce P. 16	170	2	3	26,200	
	Curtiss "Shrike" A-8	170	2	6	19,800	

GROUP D: U. S. ARMY OBSERVATION—GENERAL PURPOSE PLANES
(Outclassed in speed and ceiling by similar foreign planes in Group D—Table III.) (Unable to be protected by U. S. Army fighters in Groups B and C—Table IV.)

U. S. A.	Curtiss "Raven" Y10-40A	185	2	2	26,000	
	Consolidated 28	180	2	2	25,000	
	Douglass O-38S	165	2	2	21,500	

GROUP E: U. S. ARMY FIGHTER BOMBERS
(Outclassed in speed and ceiling by similar foreign planes in Group E—Table III.) (Unable to be protected by U. S. Army fighters in Groups B and C—Table IV.)

U. S. A.	Martin YB-10, 12, 13, (123)	170	3	2 stations	25,000	No tail gun
	Boeing B-9	170	4	2 stations	22,600	No tail gun

Tables, which were released on the floor of the House by Rep. MacFarlane on March 6, and which are included in this article. See for yourself where the policy of other nations has put them, and whose progress has reflected directly on the aeronautical progress of Japan! Then look where we stand!

These tables have been checked by our government experts, who pronounced them "conservative but accurate." The tables need little explanation. The facts presented there are only too glaring in their cold and ruthless statement of our helplessness. Our leading warplanes are incapable of even reaching similar foreign planes to engage them in battle. Our planes are deficient in elasticity of performance. Our engines are outclassed. In addition we rank third among the nations in merely the number of warplanes we have.

Actually we are far below that number because of the insignificant number of planes that are fit for service. We are sixth in the number of factories capable of building warplanes. We are the most backward of all in the design of warplanes. And note that Japan is licensed to build the best of the warplanes and engines of Great Britain, France and Germany.

After these astounding *facts* had been revealed in Congress, Secretary of War Dern bitterly opposed and fought a proposed bill for 4,384 planes and an air force separate from the army and navy. Congress blundered dully on its way in spite of the startling and ghastly revelations and in spite of the fact that we are spending on our divided air services more than any other country and are getting pitifully little for our money.

We don't want another war. We have never been aggressive in a military way. But let us by all means be prepared to defend ourselves if need be. Our isolation is a myth of the past. Continents and the oceans are getting smaller each year with aeronautical progress and we are vulnerable now! Let us by all means take a lesson from our pitiful Army Air Corps and seek our rightful and safe place in the air.

All branches of our national defense system, the over-lords and the brass-hats, have always opposed a separate air-force for very obvious reasons. From the very beginning of our military aviation, and since the time when General Foulois was paying for the maintenance of our only airplane out of his own pocket, politics has been opposed to aviation. Politics has done everything possible to obstruct progress for fear that it would lose control of a vital arm of the service.

Representatives McSwain, Byrns, Rogers and Fish are fighting for it, but Congress refuses to admit that anything has happened. For our own sakes, let us insist on unification and the abolition of a pitifully weak and inefficient Army Air Corps.

THE END.

TABLE V

COMPARISON NO. 1
U. S. Army Fighters Attacking Foreign Army Airplanes
GROUP A: FIGHTERS—SINGLE-PLACE AND MULTIPLACE

Country	Type of Warplane	Max. Speed in m.p.h. at 15,000 ft.	Crew	No. of guns	War-Service ceiling in feet	Remarks
U. S. A.	Boeing P. 26	195	1	2	30,000	Wire braced monoplane
	Curtiss "Swift" XP-934	195	1	2	30,000	Enclosed cockpit
	Berliner-Joyce P. 16	170	2	3	26,000	
	Curtiss "Shrike" A-8	170	2	6	19,800	Ground attack plane

GROUP B: FOREIGN ARMY FIGHTERS—SINGLE-PLACE
(Superior in speed and ceiling to U. S. planes in Group A.)

Great Britain	Vickers "Jockey"	238	1	2	36,000	
	Hawker "Super-Fury"	250	1	2	35,000	Vertical power dive 400 m.p.h.
	Fairey "Firefly II"	225	1	2	35,900	
	Bristol "Bulldog III A"	200	1	2	33,000	
	Gloster S.S. 19	207	1	6	32,000	Compare with "Shrike"
	Gloster "Gauntlet"	216	1	2	33,000	
France	Dewoitine 500	230	1	2	35,000	207 m.p.h. at 26,000 ft.
	Nieuport-Delage 121C-1	225	1	2	39,600	Highest war-service ceiling
	Loire 43C-1	221	1	2	35,000	
	Mureaux 170C-1	220	1	2	33,000	
Poland	P.Z.L. P.XI.	215	1	2	33,000	
Italy	Fiat C.R. 30	214	1	2	30,000	
Japan	Kawasaki 92 (K.D. 5)	205	1	2	32,000	Licensed to build *Hawker* and *Nieuport-Delage* planes

GROUP C: FOREIGN ARMY FIGHTERS—MULTIPLACE
(Superior in armament, speed and ceiling to U. S. planes in Group A. Out of reach of U. S. planes.)

Great Britain	Hawker "Demon"	210	2	3	32,000	Same armament as B/J P. 16 but greater speed and ceiling
	Fairey "Fox II"	210	2	3	32,000	
France	Breguet 41 M 3	195	3	5	31,350	Two engines
Japan	Junkers K-47	190	3	3	33,000	
Switzerland	Dornier Do. C. 4	190	2	4	31,150	

GROUP D: FOREIGN ARMY OBSERVATION—GENERAL PURPOSE PLANES
(No protection needed; superior armament, speed and ceiling. Out of reach of U. S. planes in Group A.)

Great Britain	Hawker "Audax"	210	2	3	35,000	
	Westland "Wallace"	190	2	3	35,000	
France	Mureaux 121R-2	195	2	4	35,000	
	Breguet 27-3	200	2	4	30,000	
Belgium	Renard R31	205	2	3	34,500	
Japan	Kawasaki 88	155	2	4	27,000	Licensed to build Hawker, Breguet and Junkers.

GROUP E: FOREIGN ARMY FIGHTER BOMBERS
(No protection needed because of tail guns.)

Country	Type of Warplane	Max. Speed in m.p.h. at 15,000 ft.	Crew	No. of gun stations	Tail guns	War-Service ceiling in feet
Great Britain	Vickers B.19/27	180	4	2	1	27,000
France	Amiot 141M	170	5	3	0	26,000
Japan	Junkers K-37	165	4	3	0	27,000

GROUP F: FOREIGN ARMY HEAVY BOMBERS—TROOP TRANSPORTS
(No protection needed because of tail guns.)

Great Britain	Fairey	175	5	3	1	25,000
	Vickers 163	150	5	4	1	20,000
	Boulton & Paul P. 32	155	5	3	1	18,000
	Gloster	143	5	4	1	19,000
Italy	Caproni 95	160	6	3	1	18,000
Japan	Junkers K51	160	10	4	0	24,000
	Kawasaki 87	150	6	4	0	20,000

Summary of Facts

AFTER carefully perusing the five tables presented here we find that the U. S. Army Air Corps is deficient in nearly every respect when compared with the foreign powers. Billions of dollars have been spent by our politicians, yet we lag behind much smaller countries in the matter of performance and fighting ability. Table V. tells the story graphically.

Practical Lessons

(*Continued from page* 378)

So far, we have only illustrated conditions at small angles of attack where the air-stream follows the contour of the airfoil very closely without turbulence or "discontinuity." As shown by smoke-tunnel photographs, conditions are materially changed at large angles of attack where there is much turbulence and a great difference in the nature of the flow.

When the angle of attack is increased above the angles shown up to this point, the air-stream starts to break away from the airfoil near the trailing edge. This increases the induced drag. At still larger angles, 14 to 20 degrees with most airfoils, the maximum lift drops off suddenly due to the air-stream breaking away entirely from the top surface of the airfoil. Any further increase in the angle is accompanied by a further loss of lift and increased drag.

The angle at which the air-stream breaks away entirely from the upper surface, and where the lift falls off, is called the "burble point" or "stalling angle," and if this angle is reached while in flight, the airplane will drop or "stall." Not only does the lift fall off dangerously, but the greatly increased drag tends to decrease the speed so that the situation is doubly dangerous near the ground.

And now we come to the highly important relation existing between the lift (L) and the drag (D), or the "lift-drag ratio" (L/D) which has often been incorrectly referred to as the "efficiency" of the wing. The lift is a vertical force acting against gravity while the drag is taken as a force parallel to the air-stream — horizontal in normal flight. These forces are illustrated in Fig. 8 where (L) is the lift, equal and opposite the weight or load (W), and (D) is the drag parallel to the air-stream. For every airfoil, there is a definite relation between the lift and drag for every angle of attack, but it should be noted, that this ratio varies throughout the range of angles.

Lift-drag, in short, indicates the relative amount of propeller thrust that must be employed to lift a given weight. If the lift-drag is 16.0 at some given angle, for example, then one pound of propeller thrust will be required to sustain 16 pounds of weight supported by the wings. Therefore, the higher the lift-drag ratio, the less will be the propeller thrust required and the less will be the power consumed in flight. If the lift-drag ratio is high, the wing will also glide better, thus increasing the safety of the machine.

There is only one angle of attack for a given airfoil where the lift-drag ratio (L/D) is greatest. This is known as the "optimum angle," and if the angle is either increased or decreased, the lift-drag will decrease very rapidly. Ordinarily, the optimum angle occurs between 2 and 6 degrees while the maximum lift occurs at much higher angles, 14 to 20 degrees in most cases where the L/D is low.

Just as an example of how the lift-drag ratio varies at different angles of attack, I will show some figures taken from the tests of the M-6 airfoil which has been described in the preceding lesson.

Here we see that the best lift-drag is reached at 4.1 degree angle but that the lift at this point is quite low. At -0.7 degrees, the lift-drag is only 3.0 while at the maximum lift (20.5°) it is 6.0. The lift coefficients shown here are used only in a comparative sense and will be given more detailed attention in a future lesson. The angle showing the greatest lift coefficient indicates the greatest lift.

CHARACTERISTICS OF M-6

Angle of Attack (a)	Lift Coeff.	Lift-Drag Ratio L/D
-0.7°	0.004	0.4 (Approx. 0 lift)
0.0°	0.145	3.0
2.0°	0.200	12.0
4.1°	0.357	21.1 (optimum)
8.3°	0.662	18.5
12.4°	0.952	14.4
16.5°	1.229	11.5
18.4°	1.347	10.3
20.5°	1.405	8.5 (Max. lift)
22.5°	1.354	6.0 (Stall)

We find that the distribution of pressures varies with the angle of attack, the pressures peaking up high near the leading edge at large angles, and then subsiding to moderate values near the center of the chord at small angles.

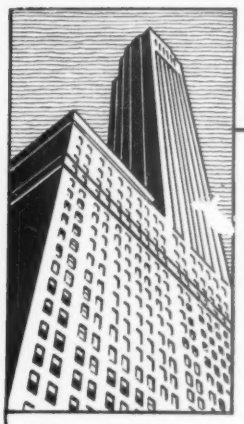
Thus, in Fig. 9 we have the pressure distribution for a representative airfoil at a high angle—in this case, 14 degrees. The pressure variations over the upper surface are indicated by the wavy line (W-Y), the magnitude of these pressures being measured by the distances a-a1-a2-a3, etc., taken from the upper surface. These, of course, are "negative pressures" or pressures lower than the surrounding atmospheric pressures. The pressure is well peaked up at (W) in front of the leading edge.

The positive dynamic pressures on the lower surface are shown by the curved dotted line (X-Y), measurement being made by the reference lines b-b1-b2-b3, etc., taken from the lower surface. These pressures are "positive pressures" above the surrounding atmospheric pressure, which it will be noted, are much smaller than the negative pressures on the upper surface. However, both the top and bottom pressures act in the same direction and are added to obtain the total pressure at any point.

It will be noted that the upper surface effect is far greater than that on the lower surface. Tests have shown that with an average airfoil the upper surface contributes about 62 percent. of the lift at an angle of 14 degrees and sometimes 100 percent. at a zero angle of attack.

Fig. 10 shows the airfoil at a zero angle of attack where the pressure distribution is much different than that above. The maximum top pressure is much reduced and has retreated to about the center of the airfoil. The total pressures, both top and bottom are much lower and hence the lift is also reduced. The dynamic pressure on the lower surface is much increased, while the pressure on the upper surface near the leading edge at (W) has "changed sign" and has become a positive pressure as will be understood from the fact that it is run down below the upper surface.

END.



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AIRPLANES

LOW wing Heath-Henderson plane, welded steel fuselage, ship and motor like new, will trade separately, pair air wheel hubs, non-brake type with adapters. Foxboro air-speed meter 0-160. Altimeter, reel of ⅛-inch steel control cable. Can use opposed twin motor, 16 m.m. Camera and projector, small metal turning lathe or what have you?—E. B. Gorham, 3439 Drummond Place, Chicago, Illinois.

STATIONARY training plane wanted, but prefer an Eyerly. Have a factory built glider, brand-new, with trailer, shock-cord, many extra parts well known make, will give a good amount of cash with glider if you have what I want.—Herman E. Kaupe, 3870 McDonald Ave., St. Louis, Mo.

LOOK! This may be the trade you have been looking for. Will trade electric 4-plate range and 5-cubic foot electric refrigerator. Value $400.00 for 2 or 3-place ship. Must be flying condition. Prefer Waco 10, or let's have your offers.—J. H. Stingley, 624 N. 10th St., Payette, Idaho.

I HAVE Hispano-Suiza 150 horsepower airplane motor, $60 aviation correspondence course, Taxidermy course, and mandolin. Want lightplane, motorcycle, outboard motor, car or what have you?—Frederick Anderson, Route 1, Box 52, New Sweden, Maine.

HICKMAN H-20, similar to Pietenpol. Model A Ford motor, steel fuselage and empennage cost $600 to build, flown 50 hours, flies hands off. Propeller and instruments were stolen, 1 spar slightly cracked. Will sell or trade for late car.—Henry Vosika, Robbinsdale Airport, Robbinsdale, Minn.

I HAVE four B. G. "Hornets" and two A. C. "Miko" plugs (18 mm), one Stromberg NA-S3 Carbureter, 1⅝ in., from a Szekely Model "O"; also a set of steel tail parts, less flippers, for Heath "V". Want nitrate dope and Flghtex fabric.—Stan Lamar, Hagerstown, Ind.

WANTED: Pietenpol Air-Camper. Have excellent Szekely and Russell Sport.—C. A. Hughes, Jr., Elon College, N. C.

HEATH Parasol, factory made, or 2 or 3-place ship—good condition—Ford—bench lathe—cash.—Blake, 9722 133 Ave., Ozone Park, N. Y.

WILL TRADE: 1930 Ford coupe, 22,000 miles, A-1 condition. Has $100.00 worth of extras for slightly cracked Waco F. May pay some cash.—C. Benner, 5427 Bates St., St. Louis, Mo.

FOR SALE or trade, 2-place Aeronca in good condition.—Wm. Radebaugh, 560 Eastern Ave., Chillicothe, Ohio.

WILL exchange the following for a good 2 or 3-place ship, any make considered: 1 new OXX6 motor, 1 new factory built steel Air Camper fuselage complete with Model A motor, 60 foot streamline tubing, 100 ft. misc. tubing, wheels, tires, instruments, safety belts and propellers. 1 7-passenger Cadillac Sedan in good condition, value $200.00.—D. Davies, P. O. Box 92, Lincoln, Nebraska.

ENGINES AND ACCESSORIES

WANTED: Parts for Szekely 30 H. P., L. head. Also a Salmson A. D. 9 in any condition.—Robert Ritz, Box 53, Greenwood, Indiana.

WANTED—Left wing for Waco Primary Glider. Have gasoline engine for model airplane, compressed air engine (six cylinder) with tank. Cash if necessary.—Ernest Berlo, 297 West St., Gardner, Mass.

PARTS for Curtis 4 NID. Four panels upper and lower, right, left. Struts, for wings, wires, complete. 1 Center Panel with struts and wires. 1 complete tail surfaces. Want motorcycle, or what have you? All letters answered. — Alfred L. Smith, Washington Crossing, Pa.

TRADE sypher bench saw for aircraft welding outfit, give some cash.—Orlo Atoc, 630 E. Main St., Lancaster, Ohio.

SWAP drawings of Borntragers car for what? Nearly new Persons Majestic tandem for any machine for good used Buddy seat.—Glenn Seeds, Newton, Iowa.

WANTED—Ace and Indian four cylinder motorcycles, engines, parts, or what have you for these cycles, will swap new and used Indian twin parts.—Bob Gurley, 10 Oxford Road, New Hartford, N. Y.

WILL trade ten sections 3/16 inch Akron pneumatic hose, new, good for welding, also goggles and tips for Oxweld, Davis, 1½ inch and 1¼ inch gasoline hose with connections, new accordion, banjo, seven hundred 2 inch and 4 inch turnbuckles fork and eye. OX-5, parts new. Shock cord. 900 feet of ½ inch and 250 feet of ⅝ inch, adjustable dies. 265-26-28 thread, and ⅝ inch—16 thread ten sets of each. Also hundred of Rusco Aero rings 5½ inch x 9/16 new, one collapsible rubber boat, new and used spark plugs, and lots of others, what have you?—John Correll, 225 W. Water St., Middletown, Pa.

CHICAGO: Offer of 20x2 and 20x4 tires and wheels was satisfactory but address was lost. Will ship on receipt of wheels or address. Will trade motors, mags or generator for a mag-generator unit for twin motorcycle.—R. Manka, Lamar, Colorado.

WANTED—Lightplane engine, 40 to 60 H.P., aircooled preferred, but will consider Ford "A" conversion. Have motorcycle and sidecar, just overhauled, new tires and battery, some cash.—Earl Guinter, 200 Lenox Ave., Colmar Manor, Md.

AIRWHEELS, tires and tubes 5.00x4. 26x4 wheels, tires and tubes. 1 new Paragon prop for Cirus. Wanted, 3 cyl. motor, typewriter, lathe, or aircraft welder.—H. A. Tice, 14906 Elm Ave., Cleveland, Ohio.

HAVE airplane instruments, 25 feet wood fuselages, turnbuckles, shackles, clevis pins, helmets, goggles, wings, souvenirs, and many miscellaneous airplane parts.—Karl Anderson, 106 Cook St., Ithaca, N. Y.

WANT 2-cylinder, 2-throw Lawrence motor complete or 3 cylinder Anzani complete. Will trade home shop woodworking outfit, 2 used 26x3 wheels, lightweight model "T" motor—H. A. Duncan, Box 1581, Beaumont, Texas.

WANTED, small outboard motor. I have Corona portable typewriter and 12 gauge repeating shotgun. Will trade either but not both. Want airplane compass in trade for Savage Sporter 22 long rifle with N.R.A. match barrel. —R. J. Paille, 217 Slater Street, Attleboro, Mass.

MODEL LN Heath fuselage, never used, also wing ribs, fittings and rear spar. Want Hisso Marine Conversion or Marine motor.—H. F. Jernegan, P. O. Box 4, Siasconset, Mass.

GLIDERS

WANTED, Power glider with power. Will trade Eaglerock fuselage with controls, seats, wheels, tires, tubes, 9-cylinder air-cooled 125 HP radial motor. Stabilizer control from cockpit, motor fits OX job. Less covering rudder and fin.—Leon M. Williams, 1315 Cummings St., Memphis, Tenn.

WANTED a glider or lightplane. Will swap a $50 clarinet with case, a 5-tube radio set and a motion picture machine or what do you want?—John Fay, 615 S. Washington St., New Ulm, Minn.

MISCELLANEOUS

YOUNG man, 20, licensed pilot, 65 hours flying time. Will go anywhere to do any kind of flying. Experience on different types of ships from 40 H.P. to 225 H.P. Make me an offer. References on request. Two and one-half years of college.—George F. Brietz, Jr., Selma, N. C.

WILL trade 4 mechanical magazines for information as to where I can secure Amikan parts. —T. E. Eveans, P. O. Box 512, Delroy Beach, Fla.

I WILL TRADE 9 issues of Aero Digest, April to December, 1932, inclusive, for Cleveland model plans.—J. Dettis, 54 Bellanca Ave., Pittsburgh, Pa.

WILL swap guaranteed King cornet and outfit for reflecting telescope, 8X binoculars, Palko camera, highpowered rifle, outboard motor, old relics, or what have you?—Mark McKenzie, Route 1, Gastonia, N. C.

YOUNG man will fly two years for $30 a month and board for anybody who will finance me through a commercial pilot's course. High school graduate, Age 18.—Horace G. Miller, Bridgewater, Va.

PORTABLE typewriter wanted. Have large number of P.A. and Mechanical magazines. Also good mandolin. Would consider small radio or what have you?—Roy Rambo, Box 86, Salina, Okla.

HAVE a Rem. Mod. 16 Auto. 22 rifle, factory sights, bore slightly pitted but accurate, mechanism perfect, excellent condition, exterior on barrel, receiver, and stock. Will trade for Sav. 23A, 42 pump preferable or new Massberg repeater with special sights. Barrels must be good. References.—W. C. Wade, Route 8, Palestine, Texas.

HAVE radio amateur station. Want midget car ready to run or what have you?—Frank Reiner, Manhattan Beach Hotel, Brooklyn, N. Y.

WANTED—Gibson or Martin guitar. Have motorcycle motors, parts and tires, 32 revolver, 32 automatic, aviation magazines and model airplane supplies to swap.—W. A. Chuhka, 442 Center St., Freeland, Pa.

RARE OFFER. Have Aero Digests, January 1929, December 1933; Aviations, November 16, 1929, October 1933; Sportsman Pilots, December 1930, June 1932.—Charles Crane, 423 Jackson St., Pascagoula, Miss.

YOUNG man 18 years old would like work with barnstormer. Will do parachute jumping or any kind of work in exchange for flying course. —V. L. Adams, Jr., Cochran, Ga.

HAVE complete Delta woodworking outfit, 80.00 rifle and cash. Want motorcycle, glider, or what have you?—Walter W. Alexander, Calhoun, Ky.

TRADE unused but fully paid American school of photography correspondence course, plane photos, etc., for a 4x5 or 3¼x4¼ Graflex with lens. Will add cash if necessary.—S. Sikora, 1218 E. 93rd St., Chicago, Ill.

HAVE $400 Cash, brand new gent's Hamilton $50 wrist watch, ladies' diamond ring, valued at $75, to exchange for good licensed airplane. Must be in Eastern part of the U. S.—W. Craig, 3310 Dent Place, N. W., Washington, D. C.

Interplanetary

(*Continued from page 374*)

the rocket reaches the height of its flight the wings open out automatically and it glides to earth.

Like the other rocket airplanes the Tiling miniature was powered with powder. It was finished only last year and given its first trial flight in Austria. The whole device worked like a charm; the rocket rose to a height of 8000 feet in a few minutes, spread its wings and sailed back to earth, making a perfect three-point landing a few feet from where it started out. Tiling was at work on a full-sized model of the same type of machine to carry a pilot when he was killed last November.

At the present time, besides Tilings work, there are at least two rocket-plane developments being carried on. Nebel has secured the support of the city and bank of Magdeburg for his project; a liquid-fuel rocket plane which will make a flight as high as its fuel supply will carry it, and then glide or parachute to earth. Just what the object of this experiment is is difficult to determine; probably to learn the behavior of rocket airplanes.

The other and major rocket-plane experiments are being carried on by Professor Goddard, the daddy of them all, with the help of the Guggenheim Foundation. His is the first real attack on the question of the poor efficiency of rocket-planes at low speeds, and with the use of models he has developed a type of machine that, although no full sized model has yet been built and it seems rather overloaded with machinery, offers great promise.

The Goddard rocket-plane is powered with liquid-fuel rockets, as it is intended to make stratosphere flights. It has the classical combustion-chamber and single exhaust at the rear. But the great difference is that when the machine is taking off or flying in the dense atmosphere near the earth, it is not driven directly by the rocket power. Instead the jet from the rocket exhaust strikes the blades of a turbine; the turbine turns an air propeller, and the propeller drives the plane. Turbine and propeller are part of a single assembly that can be cut out on arriving at high altitudes.

Reaction turbines, designed for use with high temperature gases have been under development for some time by the engine industry, but even when the blades are made of that heat resisting material carborundum, little success has been had.

Professor Goddard has taken patents on this device and for some time experiments have been under way to test the details. As he is a very reticent gentleman most of these have not yet been made public, but it is known that extensive work has been done on the question of driving the turbine with a rocket jet. In the first experiment the blades were torn from the turbine and hurled to a distance of fifty feet, so rapidly did the escaping gas come from the jet.

The turbine was reassembled, the blades being attached with still greater strength, and this time the device functioned perfectly and with tremendous speed. Matters still to be worked out include the reduction gear for connecting turbine and propeller, the controls for disconnecting the turbine and propeller at will, and a really safe and reliable method of storing the oxygen.

But work is proceeding on them and meanwhile other experimenters all over the world are turning out rocket gliders, rockets without gliders, and other applications of rocket power at a great rate. It probably will be no very long time before you will really have rocket planes soaring through the skies.

END.

China

(*Continued from page 358*)

Already plans for a gigantic "China National Port-of-Entry" to be constructed at the site of the present Lunghwa Airdrome near Shanghai at a cost of Mex. $2,000,000 are before the Nanking Ministry of Communications. Intentions are to make it the premier airport in the Far East, on a par with the best that Le Bourget, at Paris, or Burbank, near Los Angeles, can offer.

Pushing much of this idea is the Pan-American Airways. The hand of Pan-American Airways can be seen in China through a maze of subsidiaries. The Nanking government owns 55 percent. and China Airways, Inc., a Pan-American satellite, 45 percent. of the China National Aviation Corporation, which has opened the Shanghai-Canton line.

The next step will probably be taken when a tieup is made with this line at Hong Kong, from where a new link will be run to Manila. A successful test flight has been made already. Opening of the Manila run will mark the debut of Pacific-American Airways, which will then set its mind to spanning approximately 6,000 miles from Manila to San Francisco.

Service to Manila from Shanghai will definitely open next spring. Specifications for equipment are now in New York. Meanwhile, Pan-American has begun a year's schedule of "paper flights" in preparation for beginning service over the Pacific and thus adding a last link to round-the-world commercial service. This system of assuming on charts that an airline is actually in operation and checking with ocean vessels to determine how the weather is treating airplanes in "flight" was used by other interests before the South Atlantic service was actually begun.

From this data it will be determined whether to choose the northern or southern route. The former, which will be an extension of service now in operation to Alaska, will skirt the Aleutian Islands on the "Great Circle" path and will be about 1,000 miles shorter than the southern one. But the weather is also expected to be rougher. The southern route will touch such

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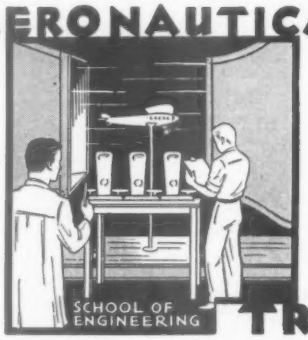

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TRI-STATE

landing spots as Honolulu, Wake Island and Guam before Manila is reached. To make it feasible there will be necessary three or four "ship islands" stationed in mid-ocean, much like the Westphalen now used on the south Atlantic line.

Other nations are interested. One European country has had success spanning the south Atlantic and is also angling for the Pacific contract. Japan is intensely interested in having such a line touch her shores and has promised a Yen 1,500,000 airdrome at Osaka if the northern route is chosen.

Even in commercial aviation within China American interests are not alone in their eagerness to exploit the field. True, the China National Aviation Corporation is now running air service the length and breadth of China. One line goes south from Shanghai to Canton; another north to Peiping. A third follows the Yangtsze River far into the interior for 2,000 miles, ending at Chengtu, near the Tibetan border. Many survey flights are being made.

But the American interests, who have played politics with Nanking, stand little chance in the south. The Southwest Political Council, practically independent of Nanking, is now ready to operate five lines linking the capital cities of Kwangtung, Kwangsi, Yunnan, Kweichow and Fukien provinces. The English are the most favored nation here. Moreover, there are reports that English, French and Dutch interests are engaged in keen competition to bring lines into the south from Europe.

This opposition has turned Nanking's eyes northward. So far the Eurasia Aviation Corporation, in which the government also owns controlling stock, has not been very successful. Four times within the past two years it has announced inauguration of air service from Nanking to Berlin, via Chinese Turkestan and Siberia. Each time civil war in Turkestan has caused a halt in traffic. Bandits and Mohammedan rebels have pillaged hangars, stolen gasoline and commandeered planes.

It was recently discontinued again and Lo Wen-kan, Minister of Foreign Affairs who flew to the northwest as mediator, found it impossible to return by air. Brigands had stolen the gasoline. So he had to return to Nanking by first going ahead to Siberia and there entraining for Vladivostok, where he caught a boat that brought him back to his own country.

Rather a roundabout trip for a high official to make but anything can happen in China in these times.

This sounds ludicrous enough. But the whole affair only took him six weeks. In days of old China, using caravan trails, he would have spent seven months.

THE END.

S. P. C. A. E-5

(*Continued from page* 370)

surfaces, like the wings, are rectangular when seen from above.

The principal characteristics of the machine are:

Length .....61 feet
Wing Spread .....92 feet
Height .....18 feet 7 inches
Total weight (loaded)..19,140 lbs.
Its performance data are:
Speed .....119 m.p.h.
Ceiling .....14,750 feet

In tests, the new machine made a climb of 8,200 feet in less than 20 minutes with full load, which is extraordinary for so heavy a craft, and reached its ceiling of nearly 15,000 feet in 50 minutes after taking off. It also proved capable of flying at 3,000 feet with full load on a single motor. Its full load radius of action is in excess of 650 miles as determined by tests, and on these tests a pay-load of 3,500 pounds was carried without difficulty.

END.

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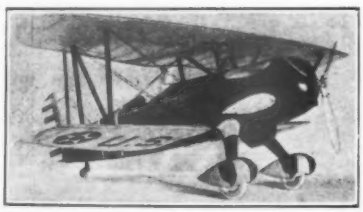
PATENT YOUR IDEA

Curtiss Army Hawk P6E



24" Span, Weight 2¼ oz., Flies 800 Feet

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5 Foot Curtiss Hawk P6E

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TO FLY ABOVE MODEL

Bore	Stroke	Height	Weight	R.P.M.
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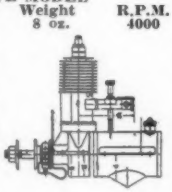
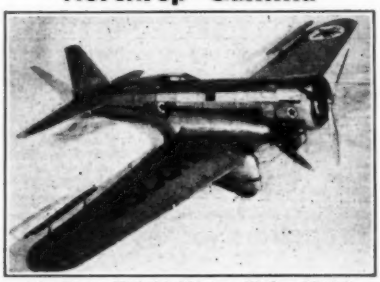


Northrop Gamma



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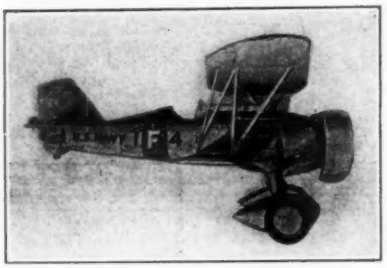

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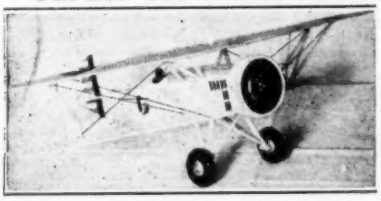

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Set includes 3" celluloid motor, aluminum motor plate and drag ring, balloon celluloid wheels with silver discs, printed instrument board, fuselage, wing and rudder insignia, aluminum pilot's seat, dope, glue, drawing and all materials. Const. Set Complete $2.50

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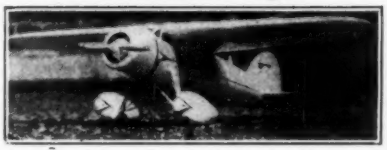

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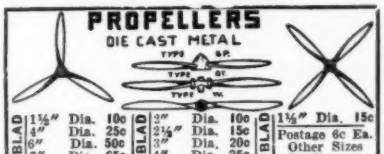

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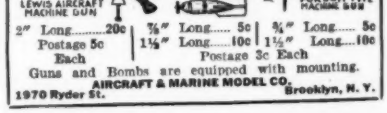

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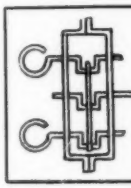

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1/16x1/8, 35, 5c	1/8 x3/16, 15, 5c	1/4 x3/8, 6, 5c
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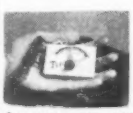

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Super-Fury Model

(*Continued from page 392*)

Great care should be taken in shrinking the covering on the wings. It is necessary to give all covered parts on the ship a coat of thin dope, after water has dried. The dope will prevent humidity from affecting the tautness of the covering.

ASSEMBLY

The wings, rudder and stabilizer are now attached to fuselage. Cut the paper from the bottom of top wing panel, where cabane struts meet ribs A. After the proper fit has been secured, a small amount of cement on upper ends of cabane struts is used, replacing the wing to dry. Check the alignment at various intervals while cement is setting.

The pin ends of the lower wings are now inserted into wing support beams in fuselage and cemented. The "V" struts between the wings are made as shown on plan.

Thread a very thin needle with black thread for bracing. This thread is best attached by passing the threaded needle through the balsa at the points shown on the plan. Always keep thread taut. The remainder of the bracing threads are attached and cemented in like manner.

PROPELLER

The scale propeller is carved from two separate blocks and cemented to the spinner.

If carefully made and balanced, it is of sufficient size to fly the model. A longer flight may be obtained by making a propeller, using fiber blades, as shown on plan.

FINAL ASSEMBLY

The dummy cowls are made from balsa, being covered with aluminum foil and cemented to fuselage. The exhaust stacks are cut from black paper.

END

Cornelius

(*Continued from page* 360)

The improved design is modeled after a seagull, with the wings attached to the fuselage like a Douglas bomber. It will be almost entirely automatic in flight, leaving only take offs and landings for the pilot to concentrate on. To remove the mental hazards of flying a ship with similar speeds, Cornelius has included a stub wing which is in the front of the assembly and gives the ship a somewhat conventional appearance while on the ground.

However, in the air this wing is seen to be the front of the ship. The front wing tends to keep the nose in the air while landing and thus reduces hazards of landing to a minimum. This is an automatic result achieved by design and is a high safety factor.

In case of acute emergencies while in the air, a plane parachute is provided. It is released from the cockpit and the method of suspension of the ship from the chute prevents the ship from oscillating while descending, heretofore a serious drawback in plane chutes. The variable wings permit change of direction of the air moving into the chute as the plane descends, thus permitting the spilling of air from either side of the chute and controlling landing at a desired spot.

Releasing the chute automatically cuts out the propellor, preventing a panicky pilot from opening his plane chute with the motor full on.

Another automatic feature is the pilot's ability to set the free wings so that they will hold a course at a given altitude and given motor speed. Advantage has been taken of known barometric pressures at certain altitudes and the automatic device works on this principle. While it is possible to land the ship with this device on, set we will say, for a course at 5,000 feet with a motor revolution speed of 3,500, if the device is not changed immediately on taking off again, it will put the ship back at the 5,000-foot level and keep it there.

No stabilizer is used, as there is no tail section. Automatic lateral stability is secured with the wing flaps which act similar to the usual stabilizer. The free wing design permits the ship to act like a swimmer going through the surf. The ordinary plane with fixed wings bounces over the waves of air and down into the troughs while the free wing slides through the peaks and depressions like a swimmer diving through oncoming waves, Cornelius says.

The wings may be removed in from five to seven minutes. This permits parking of the wings only in hangar space at the flying field. The fuselage then may be driven to the owner's home like an automobile.

To facilitate driving, the motor has two transmission systems. One is geared to the propellor on a shaft drive for air work, the other to the two landing wheels under the main wing for road work. A third wheel under the stub wing prevents nosing over when landing and steers the plane on the ground. The rudders are of semaphore type, located under each wing tip and horizontal to the line of flight. They drop down from the wing only when in use.

While two speeds are provided in the two transmission systems either one may be cut out. The gears are always in mesh and the shifting is controlled by the pilot. Use of the second gear in the air on the propeller drive gives a 75 per cent increase in power.

END

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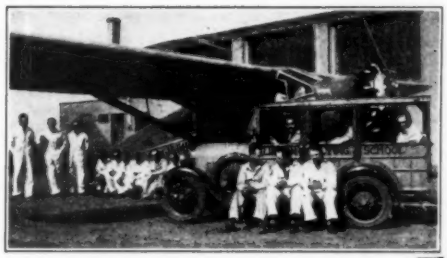

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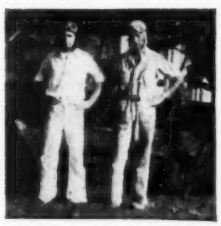

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